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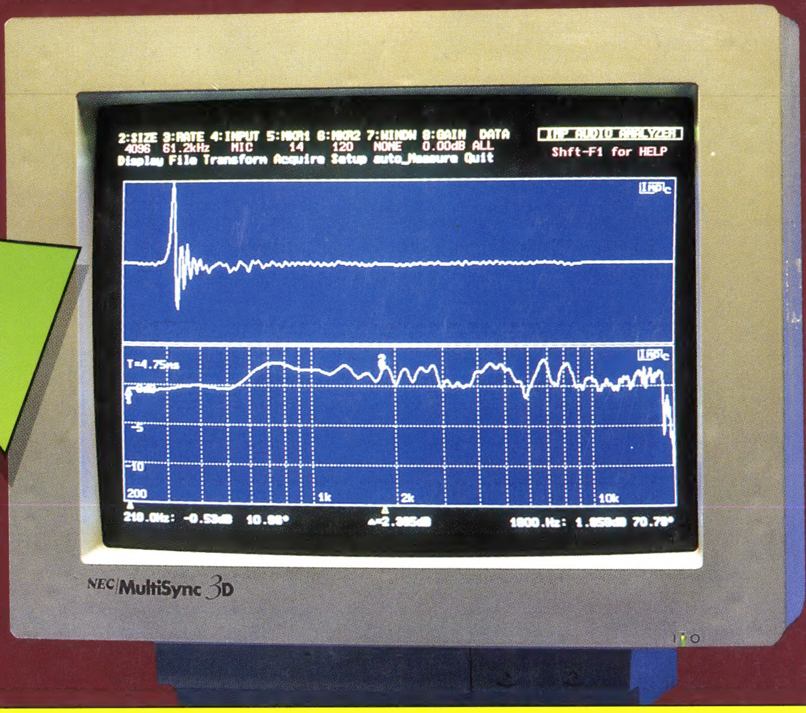
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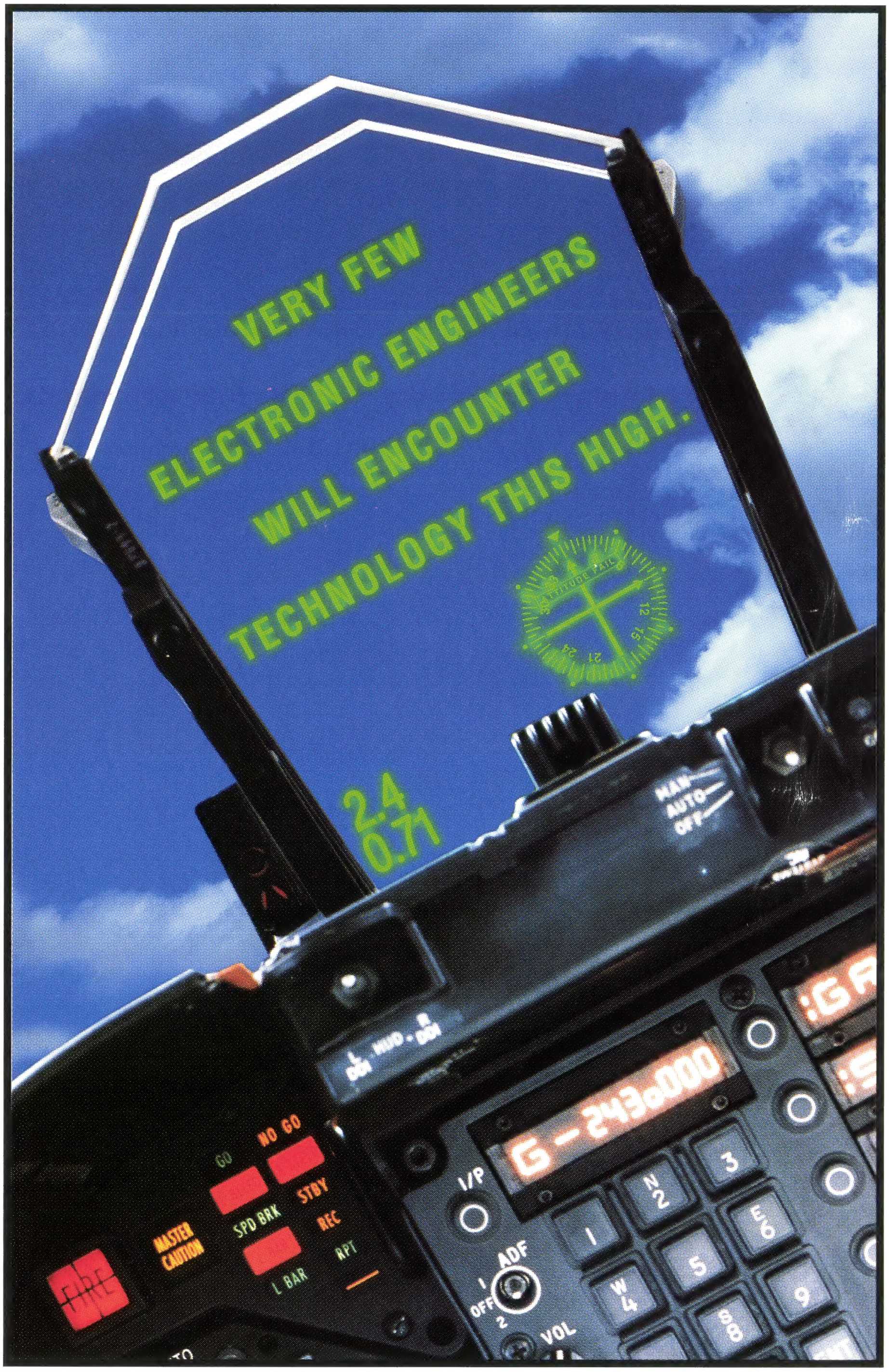

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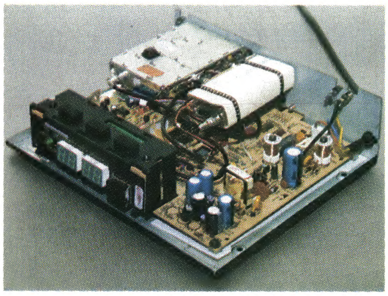
Volume 56, No.7
July 1994

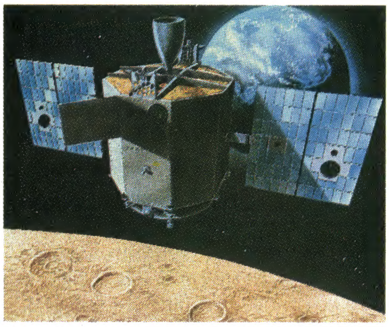
AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Inside Pay TV by cable



Pay TV looks like starting in Australia this month, via Telecom's hybrid fibre-optic/coaxial cable network. Starting on page 6 you'll find the first of two articles by industry expert Jim Davis, explaining just how this technology works at the 'nuts and bolts' level...

Low cost space probe



The US Department of Defense's space probe Clementine, now on its way to asteroid Geographos, is much lower in cost than previous NASA missions. Kate Doolan explains in her story, starting on page 20.

On the cover

Testing loudspeakers no longer needs an anechoic chamber or very expensive hardware and software. EA's Technical Editor Rob Evans has adapted a novel US design for a PC-based system, which lets you do this kind of testing 'on a shoestring'. See page 58. (Pictures by Kevin Ling)

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MANAGING EDITOR
Jamieson Rowe, B.A., B.Sc., SMIREE, VK2ZLO
GRAPHICS/PRODUCTION EDITOR
Milli Godden
TECHNICAL EDITOR
Rob Evans, CET (RMIT)
TECHNICAL CONSULTANT
Peter Phillips, B.Ed., Dip Ed., ECC
CONTRIBUTORS
Louis Challis
Arthur Cushen, MBE
Peter Lankshear
Jim Lawler, MTETIA
Tom Moffat, VK7TM
Neville Williams, FIREE, VK2XV
Major Al Younger (USAR, Ret.)
DRAFTING
Karen Rowlands
COVER DESIGNER
Clive Davis
PRODUCTION
Ray Eirth
CIRCULATION MANAGER
Michael Prior
PUBLISHER
Michael Hannan
ADVERTISING MANAGER
Selwyn Sayers
Phone (02) 353 0734; fax (02) 353 0613.
ADVERTISING PRODUCTION
Karla Dixon, phone (02) 353 0713
SECRETARY
Anna Maria Zamora
HEAD OFFICE - EDITORIAL
P.O. Box 199, Alexandria 2015.
180 Bourke Road, Alexandria 2015.
Phone: (02) 353 0620. Fax: (02) 353 0613
Reader Services: Phone (02) 353 0620
Subscriptions enquiries: phone (02) 353 9992
Book Shop enquiries: phone (02) 353 9944
INTERSTATE ADVERTISING OFFICES
MELBOURNE: 504 Princes Highway, Noble Park, Vic 3174. Phone (03) 213 3222.
Fax: (03) 701 1534, Pilar Misa.
BRISBANE: 26 Chermside Street, Newstead, Qld 4006. Phone: (07) 854 1119.
Fax: (07) 252 3692, Graham Smith.
ADELAIDE: 98 Jervois Street, Torrensville, SA 5031. Phone: (08) 352 8666,
Fax: (08) 352 6033, Kerryn Delaney.
PERTH: Allen & Associates, 54 Havelock Street, West Perth, WA 6005. Phone: (09) 321 2998,
Fax (09) 321 2940, Tony Allen.
UNITED KINGDOM: John Fairfax & Sons (Aust), 12 Norwich Street, London, EC4A 1BH.
Phone: (71) 353 9321, Fax: (71) 583 0348
ASIA: Headway Media Services Ltd, Room 2101, Causeway Bay Centre, 15-23 Sugar Street, Hong Kong. Phone: 516 8002,
Fax: (862) 890 4811, Adrian Batten.
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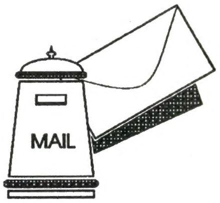
LETTERS TO THE EDITOR



MDS and Pay TV

My compliments for your magazine which I have followed since 1957...

I would like to know something about MDS (multipoint distribution system) for pay television and as the matter could be of interest also to other readers, I would be pleased if you could kindly give me an answer in your 'Letters to the Editor'.

Giorgio Giurco,
Geelong, Vic.

Comment: On page 8 in the June 1993 issue, we published an article titled 'Pay TV via Microwave: Canberra Decides Not', Giorgio. Hopefully this article will provide most of the information you're looking for.

Catalog hassle

The March issue of *Electronics Australia* arrived, but without the Jaycar catalog.

BUT I GOT IT!

Inside my copy of *Electronics Australia* is a full page advertisement telling me how. Great! It is 10 kilometres into the nearest newsagent's and 10 kilometres back. I could have written, of course I could, but this sometimes takes one week, usually many weeks.

The nearest Jaycar agent is in Port Macquarie, a round trip of over 70 kilometres. So I waited till I had to go to Port. When I asked for my copy I was told it cost $1.00.

OK — $1.00 is very little to pay for all the information contained in a Jaycar Catalogue, but there is a principle involved. Have you any idea how hard it is to carry on a hobby like electronics when you live away from a Capital city? Sometimes the kits do not reach this far, being gobbled up in the city. These catalogues are important as they tell us what is available to us and how much they cost.

I am a long time reader of *Electronics Australia* and have subscribed on an annual basis for many years. I have several copies of Hobbys, some Hobbies Illustrated, all copies of *Electronics Australia* except for 1984, and I am thinking of dropping out again.

Whatever happened to decentralisation?

David Grubb,
Pembroke, NSW.

Comment: We appreciate your position, David, but since Australia Post introduced its PrintPost system, there's a massive postage increase when the weight of a magazine and catalog combination reaches 500 grams. Unfortunately this would have been the case with Jaycar's new catalog, and neither Jaycar nor EA could afford to pay the many thousands of dollars in additional costs. So your complaint should really be directed to Australia Post, I'm afraid.

Emergency radio service?

I am writing to you about the bushfires which ravaged a large part of NSW earlier this year. There must be a better method of communicating to the public news and information regarding specific localities, instead of the vague general broadcasts the general public received.

Let me describe the situation that my family and I found ourselves in at the time of the fires. We live on the Central Coast region of NSW, on a 90 acre farm. I was fortunate to be able to stay home on the Friday the fires flared up, and was able to do the numerous tasks to try and protect property, livestock and ourselves. This was done with very thick smoke drifting around, ash and half burned debris raining down and adrenalin levels running high. We were expecting the raging fire to come over the hills at any moment.

While I was carrying out the necessary tasks, one eye was kept on the TV and one ear to the radio, trying to glean any information that was relevant to our local area. As I flicked from TV station to station, it become apparent that the news was up to a few hours old and not detailed enough about our area to be of use. Besides I did not have the time to sit and constantly monitor the TV or radio, waiting for information concerning our particular area.

Finally, the local FM radio station relayed the message for all people in our valley to evacuate. We chose to stay. A few hours later a commercial TV station was reporting that 'a big firestorm was roaring towards West Gosford.' Now was this true, or was it over-sensationalised hype? If it was correct I had made the wrong decision — there is no way I would try and fight a firestorm, (I'm a veteran of a few bushfires). Do we try to drive away, knowing that most people perish in bushfires from either lack of preparation or trying to flee from the fire?

Not knowing where the fire was, and because the phones stopped working, we again chose to stay.

Later in the afternoon people were told to return to their homes. As a final check before going to sleep at 11pm, I tuned in to a local radio station for an update — only to hear that people must again evacuate. A phone call to the police confirmed my suspicions that the evacuation call was incorrect.

Now as I reflect back to January with 20/20 hindsight, the whole system of information sharing seems to me to be crude and inadequate. The TV made for great dramatic viewing but for precise detailed information it left a lot to be desired. The local radio stations were more detailed and relevant, but did not broadcast the information regularly enough to be of much use.

Would it not be possible to have a TV channel of the UHF band that is used for emergencies? UHF transfer towers seem to be popping up everywhere these days, and most people have a TV or video with UHF capability. An official, either SES, police or controlling officer could tap into the unused channel with a computer, type in the information and have it scrolled over so that anyone with a TV set could tune in, go and do the necessary tasks, return and be updated instantly with the official information.

The initial cost of setting up such a system would be minimal as most of the hardware already exists, but a suitable format and responsibility for the information would need to be coordinated. Such a system would be useful for bushfires, floods, cyclones and any civil disorders. By using local UHF transmitters, the information would only be fed into the local areas that need it.

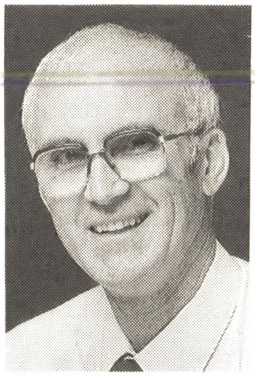
We are living in an age that is ushering in the information revolution, whose impact on society may be just as great as the industrial revolution. Surely we can set up a system better than we have at the moment.

Tony Peerenboom,
Matcham, NSW

Comment: There's certainly a need, Tony, as you have shown. It should be quite feasible to use a spare UHF channel, although Tom Moffat suggests another practical approach in his column this month.

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



How much will YOU pay to watch movies on VHS?

With Pay TV by cable finally planned to begin operation in Australia this month, it's perhaps appropriate that this issue carries the first of two articles on how the technology works — at the 'nuts and bolts' level. Written by industry expert Jim Davis, the articles take a more detailed technical look than the one we ran in the May issue, and are designed to help you gain a basic understanding of what's happening.

By the way, following publication of the May issue, we heard that people in some official circles were upset that we had attempted to provide background on the economic or political side of Pay TV — instead of just sticking to the technical side. But I make no apologies for this; I believe we technical people all *need* to be more aware of the full impact and significance of what we're involved in, not just the technology itself. And what better medium to help achieve this with regard to Pay TV, than Australia's most widely read electronics magazine?

The pollies and bureaucrats may well prefer us all to be good little mushrooms, with our heads buried in the technical 'sand', but I don't believe that's in the best interests of our society.

In fact here's another aspect you might like to give thought to, with regard to Pay TV. In a lot of my own reading on this subject lately, I've been struck by the apparent lack of emphasis on *quality of presentation* of the programme material as it reaches the subscriber. There's been lots of emphasis on squeezing the largest number of channels into the available bandwidth, on the costs of the various distribution and 'subscriber management' technologies, and so on; but very little on providing a suitable standard of programme presentation.

In fact I've been surprised to find numerous references to movie channels providing programmes derived from VHS videocassette decks, and to set-top decoders which provide only re-modulated RF signals for the user's TV receiver, rather than direct video and audio.

Now I ask you — would YOU pay $40 or more a month to watch even first-run movies that had been dubbed onto a VHS tape, played back on a domestic-quality VCR, subjected to the inevitable degradation of the encryption/cable distribution/decryption process (not to mention possible compression and decompression), and then passed through the further steps of remodulation on a low-cost RF modulator, before finally being demodulated again in your TV set? I know I wouldn't; if I *have* to watch VHS quality, I'd sooner hire a tape myself, and at least watch it at full potential quality via the direct video and audio outputs of *my own* VCR.

After all, movies played over our existing 'free to air' TV stations are already starting out at a much higher quality than VHS. If our would-be Pay TV moguls aren't planning to give us at least the *potential* to do better than this, rather than worse, I don't see too many of us rushing to sign up as subscribers. We'd be better off driving to our local cinema, to watch the movies we want presented properly.

In other countries, where Pay TV evolved from CATV/MATV systems, it may not have been hard to persuade people to pay $40 a month to watch movies of sub-VHS quality. But I doubt whether it will be that easy in Australia...

Jim Rowe

TELECOM'S NEW PAY-TV NETWORK - 1

After many years of delay, Pay-TV is planned to finally get under way in Australia this month, in the form of Telecom's system based on conventional fibre-optic and analog coaxial cable technology. But although this system is widely used and understood overseas, it's probably new to most *EA* readers. Here's the first of two articles which give a good idea of the way it all works.

by JIM DAVIS

Telecom is about to roll out a $710 million Pay-TV network which will pass over one million homes in Melbourne, Sydney and Brisbane during the next three years. Although the service will initially provide only TV-type services, the system marks the beginning of the development of an information 'superhighway' by Telecom, which will affect all Australians.

As the pay-TV information superhighway develops, Telecom expects many other services to be offered. These include televoting, home shopping, home banking, video on demand and a variety of other interactive services.

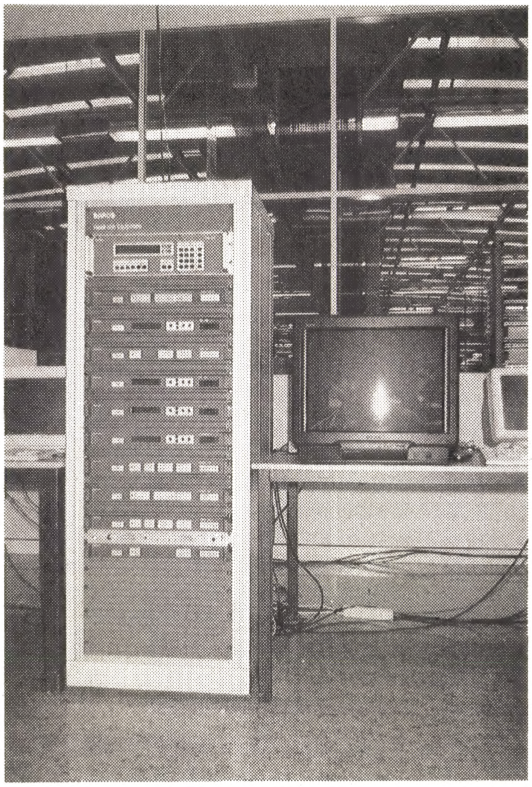
Although Telecom plans to provide the pay-TV network in many parts of Australia, there will still be about 200 towns that Telecom may leave to other developers to provide the pay-TV network. As a result it is likely that different system architectures will be used in different parts of Australia. In these two articles I will discuss the various types of pay-TV and scrambling methods that may be used across Australia.

Before starting, I would like to explain the difference between CATV and pay-TV. CATV started in the US in remote areas, where the local TV store would install a large antenna on a hill to overcome poor TV reception in his area. The store owner would then connect customers to his antenna, for a fee, in order for them to receive clearer TV pictures.

This method of centralising TV reception became known as Community Antenna TV, or CATV for short. Thus, across the US, there developed thousands of CATV companies, each serving a local community, and each using a central antenna for reception of TV signals.

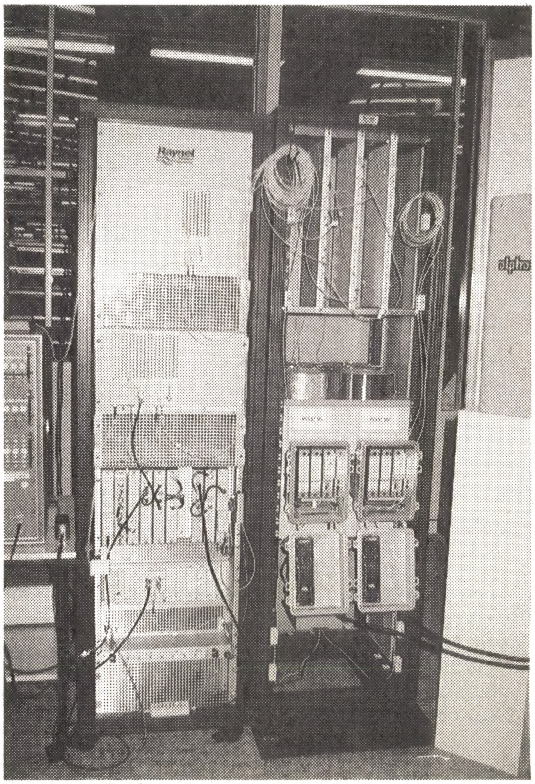
A lot of people think that CATV stands for Cable TV, and that modern cable based pay-TV systems are CATV systems, but this is not the case. The correct term for today's cable TV system is to call it a Pay-TV system.

In this series of articles I will use the term pay-TV to describe the network architecture and equipment to be installed by Telecom during the next three years. Telecom will then rent these facilities to other companies — like the Sydney based CTS — to provide programming and interactive services.



Left: A demonstration version of a four channel pay TV head end unit.

Right: A demonstration model of the optical transmission equipment needed for pay TV. The head end electrical to optical equipment is on the rack to the left, while the two optical to electrical converters are located in the right hand rack.



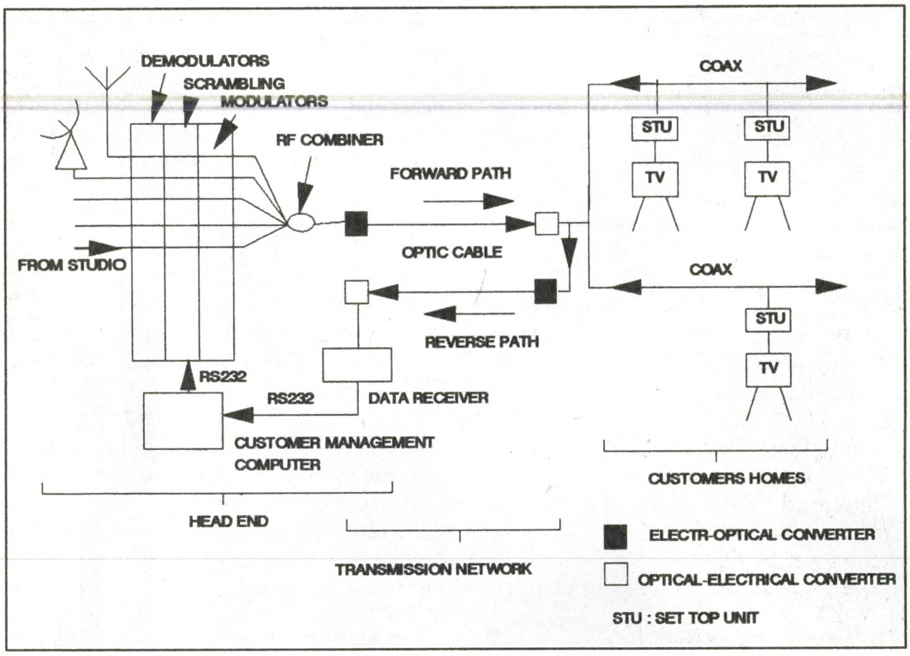


Diagram 1: Pay TV system's distribute TV signals from a central point called a head end, which also includes the customer management computer, scrambling equipment and a data receiver for the reverse path ordering information.

All pay-TV systems consist of three major components:

1. A *head end*, used to transmit TV signals onto the pay-TV network. The head end also includes maintenance facilities plus a customer management system.
2. A *transmission network*, usually made of fibre optic or coax, but often using microwave radio, to deliver TV signals from the head end to the customer.
3. *Set top units*, for use in customers' homes to receive and descramble TV signals.

The head end

The head end is the main transmission and management centre for the pay-TV system. As such, it contains TV and FM receivers and demodulators to pick up signals from satellites, microwave links or directly off-air. Off-Air TV signals, by the way, are the regular, free, TV channels that can be received using a TV antenna — such as SBS, ABC and the commercials. ther sources of TV programs could be baseband signals received directly from a studio, using Telecom's fibre optic network.

Once these signals have been received, they are individually modulated up to the correct cable-ready frequency. All the channels are then combined together before being transmitted through the pay-TV network to the customer.

Also at the head end is a customer management computer to handle billing, customer records, service calls and other day to day customer activities. Other maintenance activities are also handled at the head end, such as transmission network management and set top unit management.

Although we have talked about a head end as if it were located at one site, these functions could be distributed over many sites. Also, although a single head end could provide services to a large city, two or three head ends are usually provided for redundancy.

It should be emphasised that the head end only receives ready made programs from other sources, such as the ABC or SBS, and formats the signals associated with these programs into a form suitable for transmission to customers.

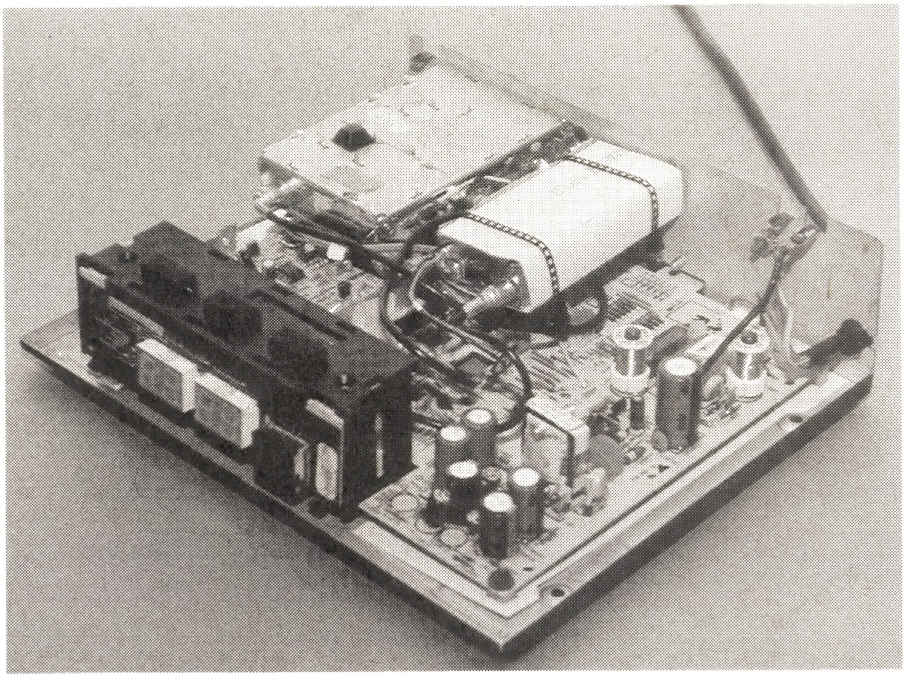
Transmission network

The traditional network topology for pay-TV has been the 'Tree and Branch' network, although with interactive services, providing an efficient reverse path has proved difficult unless a separate reverse path is installed. Many network planners therefore are looking towards 'Star' networks as the favoured network topology for the future.

In order to transmit high quality TV signals plus FM stereo sound between the head end and the customer, Telecom plans to use fibre optic cable for the main transmission backbone and to transfer from fibre to coax for the last kilometre or so to the customers home.

Telecom has laid a lot of fibre optic cable in Australia for general telephony, and much of this remains unused. This unused fibre, or 'dark fibre' as it is called (because there is no light going down it) can easily be used for the main pay-TV backbone network. Fibre has many advantages over coax:

- Large signal bandwidth;
- Often no amplification is needed between the head end and the fibre/coax interface;
- Signal quality remains high after transmission;



Inside a typical set-top unit. The demodulator and 'front end' are in the shielded metal box at the far back corner, with the digital and descrambling circuits in sealed modules underneath. (Photo: Stewart Winton).

- Fibre can easily be upgraded to handle future broadband ISDN services as they become available; and
- Fibre costs are continually dropping.

Fibre optic pay-TV systems today typically operate at a wavelength of 1300nm, with older systems operating at wavelengths of 850nm. Fibre optic cable has far less attenuation at 1300nm than at 850nm, and thus the number of amplifiers can be reduced for the same head-end laser output power.

Optical amplifiers that operate at 1300nm are expensive, however, and this has limited the amount of interest in systems operating at this wavelength. Laser technology at 1300nm is now mature and the Distributed Feedback laser well proven.

In order to gain even greater efficiency in the fibre network many companies, like the US company Raynet, are developing fibre optic products that operate at 1500nm.

Fibre optic cable has minimum attenuation at 1500nm and, with the development of erbium-doped fibre amplifiers, the optical signal can be amplified easily without first converting it back to an electrical signal. In the future, 1500nm optical networks using externally modulated continuous wave distributed feedback lasers will be the technology of choice for pay-TV network designers.

Even though the cost of fibre optic cable is comparable to that of copper, the cost of lasers, optical amplifiers and optical receivers adds considerably to the total bill for the optical network. While the cost of fibre optic technology is dropping dramatically, it is still only economical to use fibre optics in the main trunk or backbone networks, and to switch to coax for the last few kilometres to the customer's home.

Although the fibre optic network can often get away without using amplifiers, the coax network has far greater attenuation and amplifiers are spaced about every 500m. The coax network transmits electrical RF signals and attenuation is proportional to the frequency squared. Thus the attenuation at 50MHz is considerably lower than the attenuation at 550MHz and amplifier design needs to take this into account.

Calibration tones

In order to calibrate coax RF amplifiers in the pay-TV network, pilot tones of known amplitude and frequency are generated at the head end and sent out into the network together with the TV signals.

Usually there will be one tone in the lower frequency range, less than 50MHz, and a second tone in the upper frequency range, above 500MHz. These pilot tones are used by automatic gain control circuits in the RF amplifiers to automatically adjust the level of the TV signals being transmitted.

Although we have looked at the *forward* path between the head-end and the set top unit, as we will see when we consider the set top unit in more detail there also needs to be a *reverse* signal path between the set top unit and the head-end.

CABLE CHANNEL	FREQUENCY LIMITS		VISION CARRIER FREQUENCY
0	45MHZ	52MHZ	46.25MHZ
1	56MHZ	63MHZ	57.25MHZ
2	63MHZ	70MHZ	64.25MHZ
3	70MHZ	77MHZ	71.25MHZ
4	77MHZ	84MHZ	78.25MHZ
5	85MHZ	92MHZ	FM RADIO
6	94MHZ	101MHZ	FM RADIO
⋮	⋮	⋮	⋮

Diagram 2: The first 7-channels of the pay TV band plan put forward by Telecom.

Coax cable can easily pass signals in either direction, so the reverse path in the coax network can coexist with the forward path. The only additional requirement is that the coax RF amplifiers be bi-directional. Once we get to the fibre optic network, however, the reverse path and the forward path are usually separated onto two different fibre optic cables.

As interactive services become more widespread, the need for larger amounts of bandwidth along the return path will become evident. Forward path signals generally start at channel 0, which has a lower frequency limit of 45MHz, thus the frequency band from 0 - 45MHz is available for reverse path signals. If we allow a 15MHz guard band between the reverse path and the forward path, and do not use frequencies below 5MHz, we have an available reverse path bandwidth of 25MHz.

The Telecom pay-TV system will transmit PAL TV and FM radio signals in the frequency range 50MHz to 550MHz, with the band 85MHz to 108MHz being used to transmit FM radio. This frequency allocation allows up to 67 TV channels and up to 30 FM radio channels to be broadcast.

More advanced pay-TV systems allow the bandwidth to be from 50MHz to 860MHz, and in the future as pay-TV becomes more popular, this upgrade will need to be seriously considered by Telecom. In fact, when designing the pay-TV system, Telecom has allowed for such an upgrade at a later date.

Many pay-TV operators overseas are preparing for the introduction of digital television and are considering how best to make use of cable networks for this. In the US pay-TV channel allocation will be to use 50MHz to 550MHz for analog TV signals and from 550MHz to 860MHz for digital TV signals.

Using MPEG2 video compression, a digital TV signal can be compressed to less than 6Mb/s of bandwidth, and many people expect three or four digital TV channels to be compressed into this bandwidth.

The set-top unit

If the pay-TV network delivers 67 TV signals to the home in the frequency range from 50MHz to 550MHz, with most channels being scrambled, there needs to be a unit at the customer's premises which will allow viewers to select any channel they have subscribed to, and then descramble the signal. This unit, called a *set-top unit*, is about the size of a cigar box and, as its name implies, is usually placed on top of the TV set.

The set-top unit consists of three major functional areas: a 'front end' to change the frequency of the required incoming TV signal to channel 0 or 1, circuitry to descramble the TV signal, and a transmitter to send requests back to the head end — to order a pay-per-view program, for example.

As discussed, TV signals are transmitted through the fibre/coax network using the frequency band between 50MHz to 550MHz. So the first thing that the set top unit needs to do is to convert the incoming signal down to 46.25MHz or 57.25MHz, corresponding to VHF channels 0 or 1. In this way all incoming TV channels are converted to a common frequency band for reception by the viewer's TV set.

Of course, the front end must contain control circuitry to allow the viewer to choose which TV channel he wishes to watch, selection usually being performed using a small hand-held infra red controller of the type commonly used with VCRs and TVs.

Types of service

Pay-TV offers three types of services — four if you include TV channels that are not scrambled and not charged for:

- Subscription channels, where the viewer pays a fixed monthly fee to watch a specific channel or group of channels. Sports or movie channels would be included in this;
- Pay-Per-View, where a viewer decides in advance to watch a particular program. A World Cup football match would be an example of this. The customer could agree to watch this program days or months in advance and pay a fee to watch only this one program; and
- Impulse Pay Per View, where a customer decides on the spur of the moment (on impulse) to pay to watch a program that is being shown at that time but is scrambled.

Each of the above three methods of selecting pay-TV service, particularly impulse pay per view, puts special demands on the network to be developed by Telecom.

The first two services, subscription channels and pay-per-view, do not need a real-time ordering or billing system as there will be sufficient time for a customer to phone the service desk of the TV service provider, order the channel or program that he wants to view, and then wait for the service to be activated.

MITSUBISHI MOTORS
MAGNA
TOSHIBA
AKAI

In a pay TV subscriber's home, the only additional item of equipment in most cases, is a small 'set-top' unit — shown here on the top of the set.

Impulse pay per view, on the other hand, requires that a customer can be authorised to view a particular program within seconds of requesting to do so.

The first few minutes of a pay-per view program will usually be transmitted unscrambled. Hopefully this will whet the appetites of customers, sufficiently to press the select button on the hand held controller to continue watching the program when it becomes scrambled.

A signal will then be sent from the set-top unit back through the coax/fibre network, to the head end where the customer management computer will record that the customer has decided to watch the program.

The customer management computer will then send an encrypted message to the customer's set top unit, authorising it to descramble that program. The TV channel that the program is being shown on will then be descrambled by the customer's set-top unit for the duration of that program. The computer will also record on the customer's bill a charge for watching the program.

To do this, every set-top unit needs to be addressable — so that the head end can authorise a particular set-top unit to descramble a particular channel. Also, there needs to be a reverse path through the network for set-top units to signal the customer management computer located at the head end.

One leading set top unit manufacturer, Zenith, uses an 11MHz analog signal to transmit digital data back to the head end at 9.6kb/s. Most pay-TV systems now use an HDLC protocol for the set-top unit to send reverse path information to the head end.

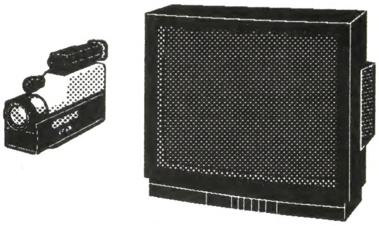
Over the coax network, both the 11MHz reverse path and the 50MHz to 550MHz forward path are sent on the same coax cable. Over the fibre network, however, a separate fibre path is used to transmit the return signals to the head end. The Zenith system sends packets of information back to the head end in real time, and up to 150 set-top units per second can communicate with the head end.

In case of contention, the set-top unit keeps a copy of the message until it receives an acknowledgment back. If no acknowledgment is received, the set top unit will re-transmit the packet after a small, but random, time interval.

Other set-top unit manufacturers, like Scientific Atlanta, use a polling method to determine if a set-top unit has a request to be sent. Polling each set top unit in turn overcomes the problem of contention, but there could be an appreciable delay between a customer making a request and the set-top unit being polled.

Continued on page 33

What's New in VIDEO and AUDIO



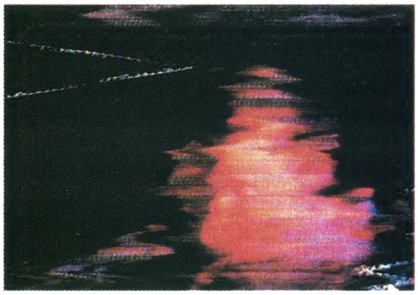
TV picture enhancement units

Skyvision Multi Satellite Systems is now able to supply two outboard processor units capable of achieving significant improvement of weak and noisy TV signals — such as those from satellite TV receivers.

The Digital Picture Processor unit incorporates DORSY (drop-out reduction system), which compares the information in each new video field with that in the previous field, and reconstructs any 'gaps' from the stored information. When used with a satellite TV receiver it is claimed to achieve an effective extension in the receiver's threshold by up to 3dB.

The Synchron Processor is a sync-pulse reconstruction device, capable of providing stable, reliable reception of TV signals that are otherwise totally unable to produce a locked image. This is done by phase-locking crystal oscillators with the incoming signal, and using the locked oscillators to insert new and reconstructed sync pulses. The unit is equally suitable for processing weak terrestrial and satellite signals.

Further information on both devices is available from Australian distributor John Papp, PO Box 472, Sanderson NT 0812; phone or fax (089) 27 4985.



Sound in Sync without processor.

The same signal after running the sync processor.

Noise-reducing headphones from DSE

Dick Smith Electronics has released a set of stereo headphones known as the Noise Buster, which employs the latest active noise reduction technology to achieve between 50% and 95% reduction in ambient noise interference for frequencies between 30Hz and 1500Hz. Signals from small microphones on each earpiece are amplified and reversed in phase, to achieve a high degree of cancellation at the user's ears. This makes the Noise Buster very suitable for listening to music and other material in a noisy environment — such as on a plane or train, or when operating a lawn mower or vacuum cleaner.

In addition to reducing the level of ambient noise interference below 1500Hz, the Noise Buster also improves the audibility of sounds above 1500Hz, to ensure that the user is not prevented from hearing important warning alarms or messages.

The Noise Buster consists of an adjustable, high quality headset with a compact and lightweight battery powered control unit which can be clipped to a belt. It can be used alone, simply to reduce the effective level of ambient noise reaching the user's ears, or in conjunction with a home or portable stereo music source for enhanced listening pleasure. Needless to say it is also very suitable for listening to in-flight movies.

noiseBuster

The Noise Buster comes with an audio cable with volume control and a 3mm plug for portable stereo equipment, plus a 6.5mm adaptor for home audio systems. It retails for $249 and is available from all Dick Smith Electronics stores.

Akai to support G-Code

Akai has announced that it will be incorporating the Gemstar 'G-Code' programming system into many of its forthcoming VCR models. Known overseas as VCRPlus or VideoPlus, the Gemstar system for simplified VCR programming is being marketed in Australia by Philips. It involves a self-contained unit into which the user keys four-digit codes for the programme they wish to record, using code numbers published in magazine and newspaper TV guides. At the appropriate times the unit then turns the VCR on and off via IR (infra-red) command signals, bypassing the VCR's own programming system entirely.

Akai will be marketing its own separate G-Code unit, as well as building the system into its new VCRs.

New subwoofer for car hifi systems

Offering power handling up to 1000W on peaks and extending down to earth shaking frequencies of 18Hz, Kenwood's latest two HQW Series subwoofers are

Three head VCR from Akai

Akai has announced the 'Referee' three head VCR, aimed at a wide market, but with particular applications for sports viewers. Offering a comprehensive range of features, including nine playback speeds, flicker-free slow motion and noiseless photograph stills, the Referee is an ideal partner for those viewers who love to capture fast sports shots. Such features are attributed to the VCR's three head technology, which offers added quality in still and slow modes over two head models.

The Referee also incorporates Akai's award winning 'Auto-Tuning' Intelligent HQ technology, which enables outstanding picture quality to be obtained from all tape grades. Simply put, I-HQ matches the VCR's recording and playback parameters with the characteristics of any video cassette tape being used, to ensure optimum performance.

An Auto Head Cleaning feature is also incorporated in the Referee, which is engaged automatically whenever a tape is loaded or unloaded. The Referee also features Akai's proprietary IMS or Interactive Monitor System, which displays programming information on the TV screen in a selection of up to eight languages.

The Referee has an RRP of $499 and is covered by a 12 month warranty. For information of your nearest dealer ring (02) 763 6300.

aimed at those users wanting maximum bass from their car systems.

Sporting a new Kenwood 'logo', the new 300mm/12" KFC-HQW300 and 250mm/10" KFC-HQW250 subwoofers supplement Kenwood's other HQW series subwoofers, making a total of six driver models. Both the KFC-HQW-300 and KFC-HQW250 employ heavy duty, double layer strontium ferrite magnets that are specially chosen for their extremely high magnetic properties. The end result is two subwoofers that deliver unprecedented yet well controlled bass extension.

To handle the large amounts of power, both units employ very large voice coils of 80mm (KFC-HQW300) and 74mm (KFC-HQW250) in diameter; this also serves to offer increased stability. Making the voice coil wider also reduces distortion, particularly at low frequencies, by offering greater control over the cone area.

A triple spider made of polyamide elastomer supports the cone, keeping the voice coil central even during high energy, long excursion operation. The end result is much lower distortion, by preserving the high linearity when handling high powered transients.

The cone and magnet are supported by a diecast aluminium frame construction and an integral 24-fin heatsink, which aids in heat dissipation as well as providing structural strength.

New laser disc player from Kenwood

Kenwood has announced its latest home theatre product, the LVD-930R laser disc player. Designed to accept all current types of laser discs and CDs including CD-Vs, the LVD-930R incorporates the company's latest single-bit (DAC-7) audio technology.

Kenwood's research had found that many competitive laser designs, although delivering excellent video reproduction, often neglected the audio section. With this in mind Kenwood have focused on bringing the audio quality up to par with that of the video.

The end result is DAC-7 technology, which incorporates eight times oversampling filtering for sonic audio quality comparable to the finest CD players. Whether the unit is employed as a standard CD player or laser disc player, the LVD-930R is equally at home. For those audiophiles who demand the purest of audio quality, Kenwood have also included a direct 'CD' position switch that by-passes all but the most essential audio circuits. Three independent D to A converters act upon the chroma, luminance and composite signals to recreate picture detail that Kenwood contend is unrivalled in brilliance. The LVD-930R features Auto Reverse and offers one of the quickest changeover times in the industry.

To achieve an exceptionally noise free picture, Kenwood have incorporated a Digital Noise Canceller circuitry which aids in the reduction of random noise. For connection to the very highest quality monitors, the LVD-930R is configured with separate chrominance and luminance outputs (Y/C separate and S-VHS connect).

The LVD-930R has an RRP of $1999 and is covered by a three year warranty (12 month warranty on laser pick-up).

KENWOOD
KENWOOD

High speed cassette duplicator

The new Otari DP-4050F Series In-Cassette Duplication System features 16-times duplication speed.

The result of 25 years extensive experience in duplication technology, the new DP-4050F-C2 Cassette Duplicator, providing simultaneous duplication of two cassettes from one cassette master; the DP-4050F-Z2 Cassette Slave Expander, providing three additional cassette slave transports; the DP-4050-OM Open Reel Master, for 1/4" master tapes in open reel format; and the DP-4050E-Z Buffer Unit, a bias signal buffer unit for driving up to six Z3 slave units in a large configuration.

Features of the DP-4050F series include: switchable 8/16 times duplication speed; simultaneous stereo copying of both sides of a cassette; automatic rewind of master and slaves at the program's end; microprocessor controlled three motor transport mechanisms; highly reliable four channel in-line ferrite heads; fixed/variable master player pitch control; independent and adjustable bias, level and EQ for each channel, LED azimuth indicators; and large mechanical VU level meters for each channel (C2 and OM).

For further information contact Amber Technology, Unit B, 5 Skyline Place, Frenchs Forest 2086; phone (02) 975 1211 or fax (02) 975 1368. ❖

Video & Audio: The Challis Report

SONIQUE AUDIO'S 6.5 LOUDSPEAKERS

As noted in our Video and Audio columns recently, a new loudspeaker design and manufacturing firm has been established in South Australia by former Duntech executives Greg Walden and Steve Lund: Sonique Audio. For this month's review Louis Challis was able to test and audition the top system in the firm's inaugural range, the Sonique model 6.5.

When my wife and I attended our first subscription concert at the Sydney Opera House this year, on opening the program my eye was drawn to an advertisement of Len Wallis, who is one of Australia's most renowned hifi dealers. Len's ads are well presented — but what caught my eye was his singing the praises of a new brand of Australian loudspeakers, and specifically their 'top of the line' model Sonique 6.5. I would not have given that incident any more thought, had it not been for a phone call from *EA*'s editor next morning suggesting that I might like to review the new Sonique 6.5 loudspeakers.

I was then told that the principals behind Sonique Audio Pty Ltd are Steve Lund and Greg Walden, two men with considerable experience and good track records in the design and marketing of quality loudspeakers. My response, naturally, was YES!

A few days later, a large cardboard carton containing two speakers arrived at the office. The Sonique 6.5's are tall and relatively thin, with well finished attractive cabinets. The speaker driver configuration is a tad different to most other comparable speakers, as the design is actually a two way system with three drivers.

The Sonique 6.5's have two low frequency drivers, with one above and one below the tweeter. This configuration is claimed to offer considerable advantages, by way of a more uniform point source emission characteristic. More significantly it provides a phase linear sound emission across the frequency spectrum, within the primary sound emission area.

The uniformity of high frequency sound emission is further enhanced by the addition of two layers of sculptured felt, whose positions have been carefully determined and which are located on the two outer sides of the tweeter's face plate.

The sculptured felt pads attenuate the residual (unwanted) reflections of sound which would otherwise be produced by the inner edges of the frame which supports the grille cloth cover, and similarly for sound reflections from the face of the speaker cabinet itself. This technique is now well proven, and in the case of the Sonique 6.5's, is particularly effective.

The base of each speaker is different to other speakers, as it is encapsulated in a black moulded plastic boot. The underside of the plastic boot incorporates four captive nuts. These in turn provide a means of securing four extremely sharp floor spikes, with which the speakers may be 'anchored to the floor' for enhanced stability. Whilst this concept may be attractive to the manufacturer, it is generally abhorred by most home lovers, as relatively few people (apart from the most devoted), will mutilate their floors in that way.

Enhanced tweeter

The Sonique 6.5's tweeter is a new 26mm diameter ferro-fluid cooled driver unit, produced by VIFA in Denmark. It's different from previous generations of VIFA tweeters, and incorporates some important advances. The most obvious of these is its adoption of a double cavity within the rear of the magnet yoke structure. This supplementary cavity linearises the air damping and effectively smooths out the lower end of the tweeter's frequency response.

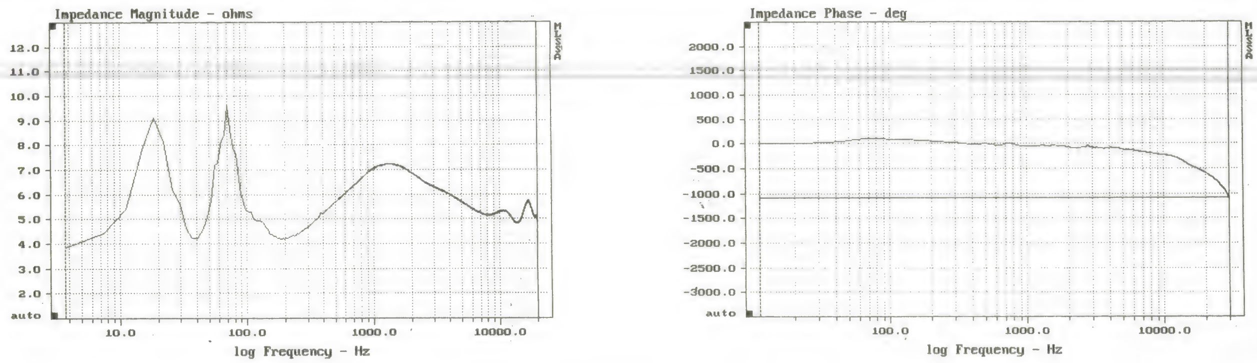
The two low-frequency drivers are also manufactured by VIFA. Each has a 173mm diameter 'mineral' loaded polypropylene diaphragm, with a very flexible and especially damped rubber surround. Although these low frequency drivers are relatively small, their performance is considerably better than might be anticipated on the basis of their size alone. Of course using two drivers instead of the normal one provides a further 3dB increase in peak output, and more closely matches the sensitivity characteristics of the tweeter.

The drivers and crossover network have been designed on the basis of potential 'bi-amplifier' drive, where required. Two pairs of gold plated terminals with matching gold plated links are provided in a recess near the base of the rear panel of each speaker enclosure. The crossovers appear to be well constructed and incorporate air-cored inductors, high voltage polypropylene capacitors and large ceramic-cored resistors mounted on a solid printed circuit board. The crossover frequency has been judiciously selected to take optimum advantage of the tweeter's lower natural roll-over characteristic. This results in a simpler crossover network, which then provides better performance with fewer potential vices.

The concept of bi-amplifier feeding is not new, and in some circumstances offers advantages, especially where the length of cable between amplifier and speaker becomes relatively long. The obvious disadvantage with this concept is the need to provide a costly second pair of amplifiers, quite apart from the need to correctly adjust the second amplifier's sensitivity to retain the overall balance.

Solid cabinets

One of the most obvious attribute of the Sonique 6.5's is the *solidity* of their cabinet design. They use a tall and slim profile, with



Left: /The input impedance of the Sonique 6.5 speakers generally conforms to a four ohm system, with peaks at 28Hz and 70Hz and a gentle rise around one to two kilohertz. At right is the phase response of the speakers, which as you can see, is commendably smooth over the full audio range.

excellent internal stiffening and a particularly well veneered exterior. The manufacturers offer three different veneers (standard colour Jarrah, black or optional clear), and they appear to be as well finished as any imported Danish speakers which I have reviewed — which currently set the 'standards in furniture quality'.

The cabinet uses a bass-reflex design, and incorporates a smoothly contoured external port, but without the same loving care being applied to the *inner* end of that port.

While sharp edged reflex ports with small diameters sometimes generate audible 'panting' at high drive levels, I was unable to detect any such problems with this porting system. I examined the inside of the cabinet and noted that the design uses 50mm thick urethane foam on both sides of the cabinet, but with no linings on the front or back faces. This approach is obviously adequate, and certainly proved to be effective.

Subjective testing

The Sonique 6.5's looked attractive enough for me to take them home for the Easter weekend to audition them, as well as to measure their room response characteristics before I commenced my full objective evaluation.

As it happens, that proved to be a fruitful and pleasant decision. I soon discovered that Len Wallis' comments appeared to be accurate and in this circumstances, well warranted.

The first test that I performed was to evaluate their performance with a new test disc which is the best of three recently released by Sheffield Lab. This particular disc, which is 'The Sheffield/Coustic Test and Demonstration Disc' (10040-2-T), offers the novice user more practical and useful testing and demonstration material than any other currently available test disc. Track 18 provides five minutes of pink noise, which is useful for audible assessment or comparison of a speaker's characteristics, quite apart from its use with a one-third-octave band real time analyser to determine the room average response, which requires multi-point sampling.

As I discovered, the one-third-octave band room response displays a gentle peak at 40Hz, a slightly higher peak at 100Hz, and an additional gentle peak at 6.3kHz. With pink noise there is an audible tonality or colouration which detracts slightly from their overall performance, and the absence of which would have lead me to describe these as monitoring speakers. The pink noise performance was nonetheless very good, and most certainly better than average for speakers in that price range.

Whilst I played 'The Sheffield/Coustic Test and Demonstration Disc', I evaluated the Sonique 6.5's performance with bi-amplifier drive, and tracks 11 to 16 provided me with a simplified method of checking the audible sensitivity in the absence of a sound level meter or real time analyser. I re-checked the aural adjustment with my real time analyser and found that my aural adjustment was only out by 1dB (I was 1dB high for the tweeter amplifier drive).

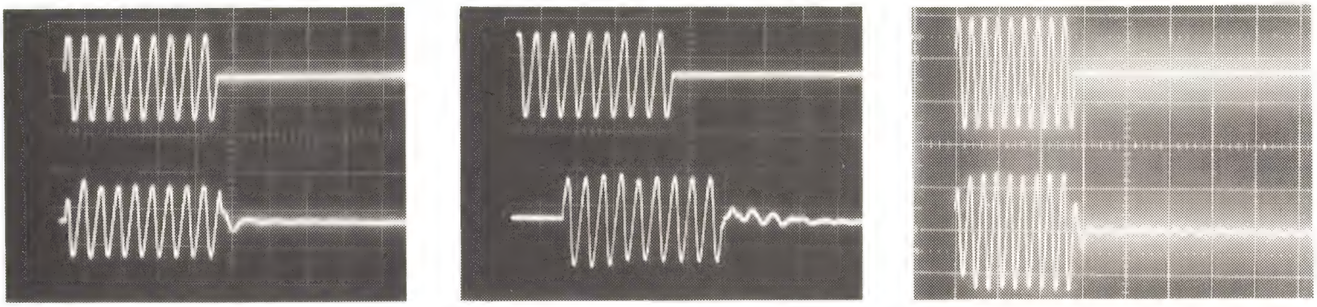
Whilst I had the Sheffield disc in the CD player, I also used Track 1, which is 'A Sonic Demonstration' and Track 2 with 'Clair Marlo & Colleagues: A Major Technicality' playing a combination of 26 synthesisers mixed with live instrumental music. This exciting music beautifully displays the prowess of these loudspeakers, and was very impressive.

My test panel and I immediately came to the conclusion that the Sonique 6.5's were an exciting Australian development.

I progressed to an outstanding new Australian disc 'Mozart Arias' which was recorded in the Newcastle City Hall in December 1993. The disc features the Australian Chamber Orchestra, with Yvonne Kenny as the soprano soloist and Richard Tognetti as an instrumental soloist and director (Sony Masterworks SK 66282).

This is a special disc, and I consider it to be one of the best Australian recordings that I have heard in recent years. It is a testimony to the quality of Australia's recording industry and confirms that we can produce

Tone Burst Response of Sonique 6.5 Loudspeakers (for 90dB Steady State SPL at 2m on axis)
Upper trace is electrical input — lower trace is loudspeaker output



100Hz (20ms/div) **1kHz (2ms/div)** **6.3kHz (0.5ms/div)**

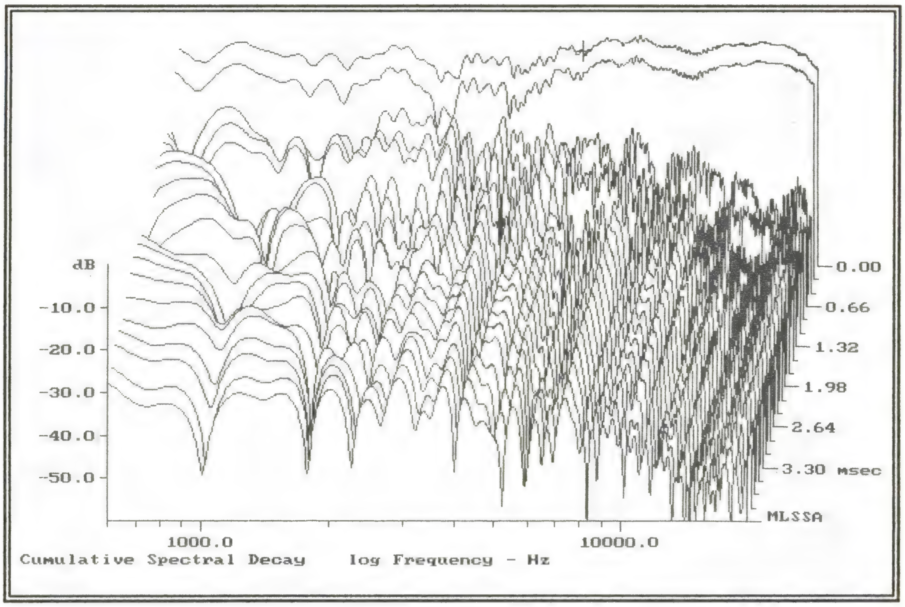
recorded material whose inherent qualities equal the very best imported software.

This disc provides first class and very appropriate test material with which to evaluate the comparative sound reproductive characteristics of the Sonique 6.5's, by way of comparison with other reference speakers. As my test panel and I discovered through repetitive A-B, A-B evaluations against my monitor reference speakers, with input of human voice and orchestral music, the Sonique 6.5 loudspeakers perform extremely well, and are relatively close to being faultless in their reproduction performance.

We followed this evaluation with the new set of 'The Glenn Gould Edition' of Bach's Toccatas, BWV910-916 (Sony Classical SM2K52612). As I listened to the first track on disc No 1 with the Sonique 6.5's, I became immediately aware of an aberrant sound, which confused me. There appeared to be somebody humming the music in the background, and as I soon deduced, Glenn Gould was providing his own accompaniment in the background.

At first I was bemused by this unusual feature. As I continued to listen to the disc, my attention was riveted not so much by the music, which was great, but more by Glenn Gould's humming.

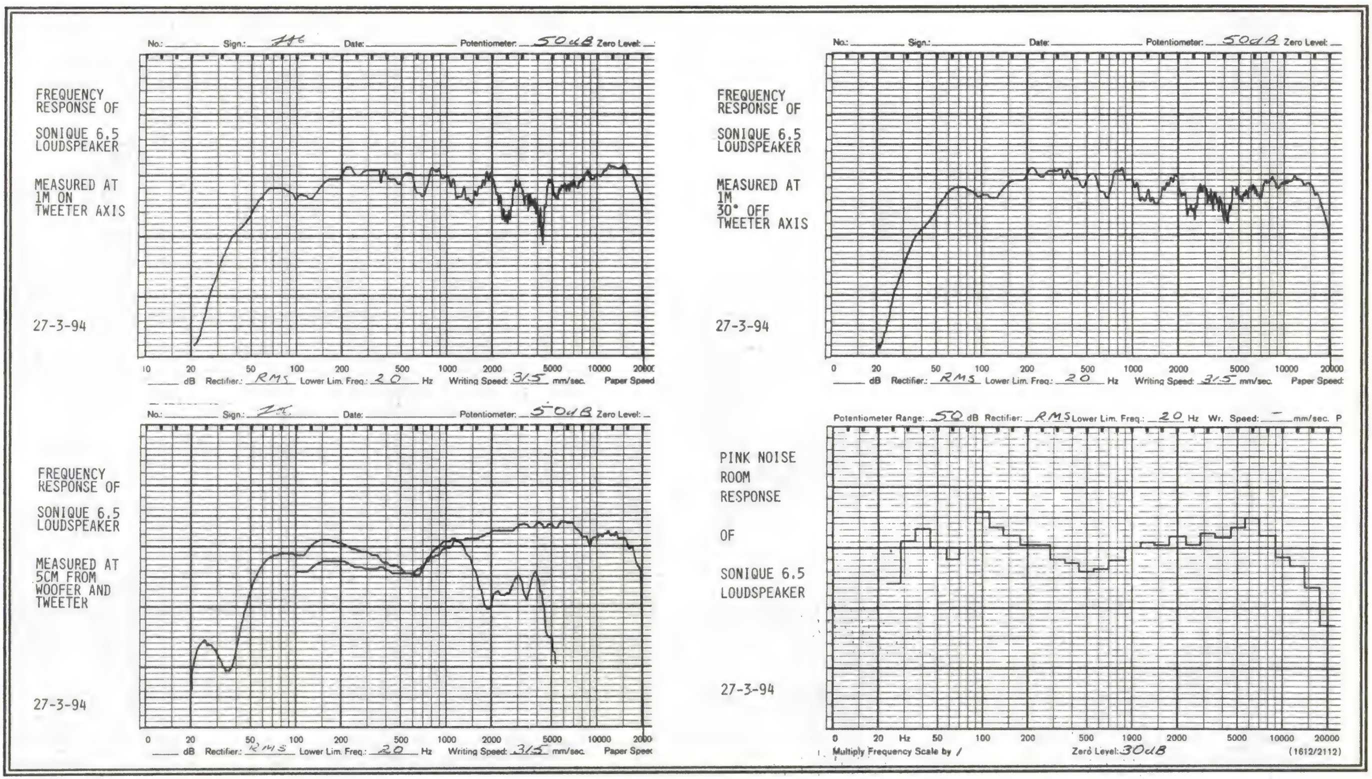
What I noted was, that it sharpened my attention, and instead of detracting from the music as I might have originally thought, it unquestionably added to the milieu, and consequently I now regard these two discs in a somewhat different light. The quality of linear reproduction of the Sonique 6.5 loudspeakers simplified the auditioning task, and as I subsequently discovered when comparing the output with lesser speakers, they highlighted the nuances in a way which lesser speakers simply could not match.



The decay response spectra of the Sonique 6.5's. As you can see, it's quite smooth over all, with only minor variations.

We played Glenn Gould's music even louder. The humming was louder, but more significantly, the speakers handled the staccato piano notes without any obvious problems by way of added audible distortion. They reproduced the concert hall playing levels with an unusually impressive degree of realism.

For our fourth demonstration disc, I selected a new disc entitled 'Engineer's Choice', (Delos — DE3506). The contents of that disc were selected by the renowned American recording engineer John Eargle,



Measured frequency response plots for the Sonique 6.5 speakers. At upper left is the overall response at 1m on the tweeter axis, with the response at 30 degrees off axis at upper right. Lower left are the individual driver responses measured at 5cm, while at lower right is the pink noise room response measured with one third octave filtering.

MEASURED PERFORMANCE OF SONIQUE 6.5 LOUDSPEAKERS
Serial No. A & B 000212

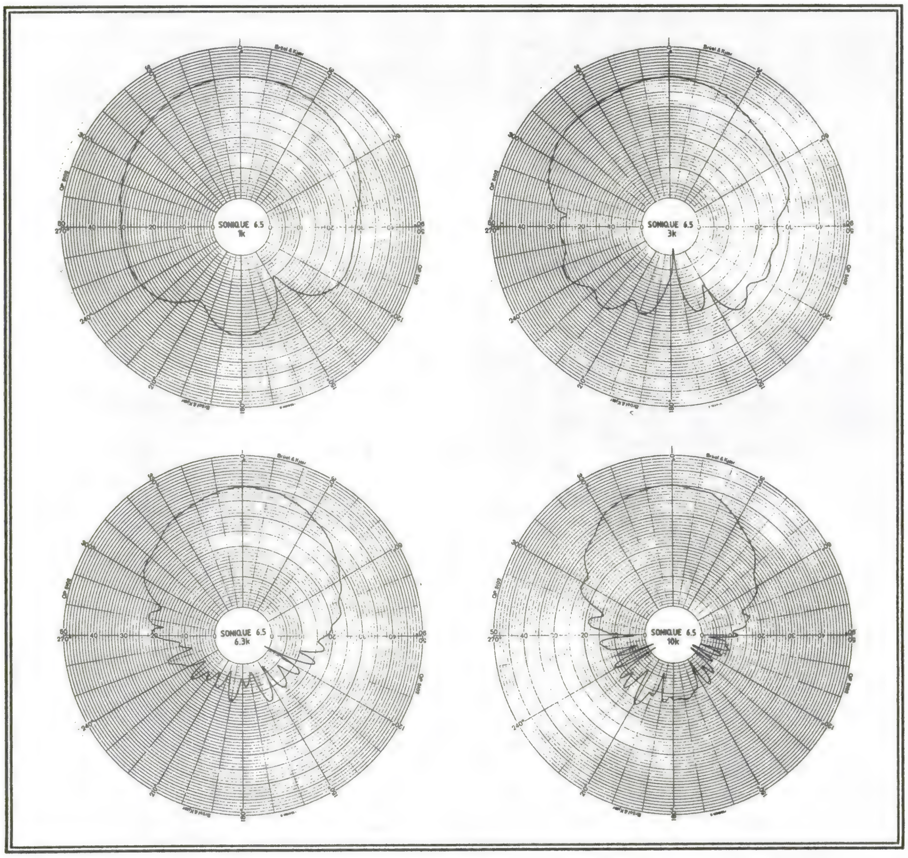
Frequency Response		43Hz to 19kHz = +/-6dB		
Crossover Frequencies		Nominally 2kHz		
Sensitivity (for 90dB average at 2m)		nominally 88dB for one watt into four ohms		
Distortion at maximum output level = 90dB @ 1m on axis				
		dB 100Hz	**dB 1kHz**	**dB 6.3kHz**
	2nd	-47.3	-44.0	-57.7
	3rd	-59.0	-52.9	-53.7
	4th	-66.6	-67.6	-69.0
	5th	-72.2	-61.5	-
	THD	0.5%	0.7%	0.3%
Input impedance		63Hz	8.2 ohms	
		250Hz	4.4 ohms	
		1kHz	7.1 ohms	
		4kHz	6.0 ohms	
		8kHz	5.2 ohms	
Minimum at 200Hz = 4.2 ohms				

who as well as being an ex-president of the Audio Engineering Society, is also a respected journalist, author and sound engineer. He has selected 22 of the best excerpts from the more than 80 recordings which he has produced for Delos over the last decade. The material he has selected is very impressive, and perfect for displaying or evaluating the characteristics of a loudspeaker system.

We soon observed that the Sonique 6.5's were equally impressive, and far more so than we might have anticipated on the basis of either their size or price. The subjective assessment was unquestionably a success!

Objective testing

After the Easter weekend, I took the Sonique 6.5 loudspeakers into the laboratory to examine their objective performance. Once again I was impressed by the measured parameters that these speakers displayed.



The measured polar characteristics of the Sonique 6.5 speakers, at the usual frequencies of 1kHz, 3kHz, 6.3kHz and 10kHz. They are very smooth...

The 'on axis' frequency response is excellent from 50Hz to 20kHz, and although there is some small obvious nonlinearity between 2 - 3kHz (as a result of the crossover), and again a discontinuity between 4 - 5kHz, this does not significantly detract from the overall performance. The 'off axis' frequency response in the anechoic room is marginally smoother than the 'on axis' response, and one is immediately impressed by the lack of gross dips and bumps.

The polar plots of the Sonique 6.5's are smooth and impressive, and within the +/-30° arc only start to show significant droop, in the order of -5dB, at frequencies above 10kHz.

The next phase of my assessment was to measure the decay response spectra of the Sonique 6.5's. These were reasonably smooth, and most certainly better than I might have expected. The tone burst responses were also reasonably good, and displayed characteristics which were generally better than the norm.

The distortion characteristics for 90dB at 1m were also remarkably good, with less than 0.5% THD at 100Hz and less than 0.7% THD at 1kHz. The input impedance of the speakers basically conforms to a 4-ohm system impedance, with two primary peaks at 28Hz and 70Hz, which were nine ohms and 10.6 ohms respectively. There was also a gentle rise in the 1 - 2kHz region which was 7.3 ohms. The input impedance has been selected to extract maximum possible output from a conventional transistorised amplifier, and should cause no problems for any normal amplifier.

The last test I performed was to assess the phase response of these speakers. This again proved to be relatively smooth, but more significantly confirmed that what we had heard agreed fairly well with what we were able to measure.

Summary

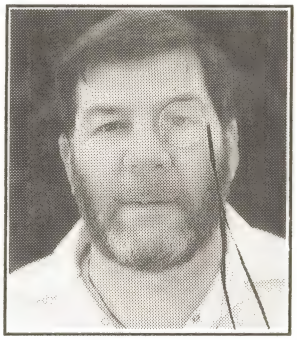
The Sonique 6.5 loudspeaker system achieved a standard of performance which was excellent and which borders on 'outstanding'. This has been achieved at a recommended retail price which appears to be well within the range of significant proportion of prospective purchasers.

The performance that is achieved is unquestionably on par with the vast proportion of imported competitors, but more significantly this product is designed and manufactured in Australia. If you believe in the concept of buying Australian, and you wish to purchase a new set of loudspeakers, then you would be hard pressed to look beyond the Sonique 6.5's to get excellent value for your money.

The dimensions of each Sonique 6.5 enclosure are 1054 x 216 x 268mm (H x W x D), and they weigh 20kg each. The RRP for the system is $2295. For further information contact Sonique Audio, 14 Kindale Court, Pooraka 5095; phone (08) 262 7911 or fax (08) 262 1189. ❖

Moffat's Madhouse...

by TOM MOFFAT



It's about time we spread the word

I've just spent a few days on Maria Island, off the Tasmanian coast. What a strange place it is, totally isolated. There are animals common on the Australian mainland, but unknown in Tasmania. There are Forrester Kangaroos grazing in the grassy paddocks, and the occasional large emu. Cape Barren geese strut around, and native hens constantly keep the campers awake, squabbling over territorial rights (the hens', that is...)

And, like everywhere else in Australia, there is evidence of bushfires. On long bushwalking journeys around Maria Island I saw the blackened trees, and had plenty of time to think about how they got that way, and then about the terrible fires that tore through New South Wales at the beginning of this year. They sounded so much like a rerun of Tasmania's 1967 disaster. Brave firefighters abandoned their jobs or their holidays to try to fight back the flames. And they succeeded, too. In New South Wales homes were lost, but many more were saved.

When the fire threat finally subsided the fire crews returned home to a hero's welcome, which they certainly deserved. But a few days later, as surely as night follows day, the recriminations began. Politicians argued, rednecks mixed it up with the greenies. Blame for the fires was pushed in every direction. But some good suggestions did come out of the discussions. I've thought about it a lot too, and now I'd like to toss a few ideas into the melting pot. Bear in mind that these are only my own personal opinions, certainly not those of the firefighters who know a lot more about it than me. But see what you think...

Communications problem

It seems to me that the biggest problem in New South Wales was communications. People who could see bush blazing just behind their houses turned on their radios, only to hear the stations broadcasting stories of fires far removed from them. I would suggest that the fire stories that got to air were those selected for their news value. In other words, if an area of million-dollar homes was threatened, this was considered more newsworthy than a fire threatening an area populated by average Joes.

This is not just the idle ramblings of a cynic. I have been there and done that, having spent many years as both a producer and journalist in radio and television news. Given two fire stories of equal size, one in a working-class area and the other in a ritzy area, and given a limited amount of air time, I know which story is going to get a run.

However a station can't broadcast what it doesn't have. During the New South Wales fires I spent a lot of time here in Tasmania listening to the ABC's Triple-J. This is basically a Sydney station which is networked all over Australia, so what we heard here was a local station broadcasting to its own people.

Triple-J's target audience is young people (and the young at heart) so their staff are young as well. This means there are none of those hardened old newsmen using their networks of contacts to ferret out stories. For many of the Triple-J people it would have been their first disaster, but they were handling it with surprising resourcefulness.

We'd hear someone say "there's an unconfirmed report that there's a fire heading toward suburb-X" or "we understand the road has just been closed at Y". This information was most likely gleaned from phone calls, both incoming and outgoing. Some reports would conflict with others; some would be unclear. So the poor bod running the on-air shift would simply have to take a big punt at times to decide what to broadcast.

At times like this, if you *do* try to confirm reports officially, you're most likely told to 'bugger off, get off the bloody phone'. The person on the other end, at a fire or police station, has enough troubles on his hands without calls from the media.

This is why we have 'media liaison officers'. The purpose of these people is to disseminate official government information to radio and TV stations and newspapers. But for the information to be 'official', it must usually be approved by someone high up, in many cases the Minister. And approval takes time, and time, and more time... In my own experience I have been kept waiting for days by the Government Media Office, in response to what seems to me to be a simple question.

Need for approval

Reports from Sydney suggest that in some cases it took up to one and a half hours for media liaison officers to release information on particular fires. By then, whatever was threatened would be well and truly burnt. Although it wasn't said so, I suspect 'official approval' was the main cause of the delays. So radio stations were getting phone calls from residents saying their whole street was on fire, while 'official' sources had to 'officially' deny that the fire in question existed!

We can't blame the media liaison officers solely for this situation. They are working within the restraints of the Australian public service, which has its roots in the British model where secrecy is everything, and unauthorised speaking out is forbidden.

Most media officers are journalists, and they should be given the credit of having enough *nous* to gather and disseminate correct information without needing it rubber-stamped by some person who in many cases is little more than a figurehead. In the case of the New South Wales fires, I think the media officers should have been given police scanners and telephones and told to go for it. They should have been allowed to answer any inquiry instantly.

Scanning radios are a wealth of information. You can instantly tell where the trouble spots are, where people are calling for more assistance, where firefighting resources are being concentrated. You can instantly tell what roads are closed, what roads are open. The trouble is, if you are a radio or TV station, federal law makes it an offence to make use of the information.

If you got on a station like Triple-J and said "we just heard on the police radio that Frog Street has been blocked by burning trees", you would be in very big trouble with the government. The correct procedure would be to ring the Media Liaison Office and say "we just heard that Frog Street is blocked by burning trees. Is it true?" And the Media Liaison Officer would say "I'll have to get confirmation and get back to you..." And then you wait and wait, while the slow wheels of government grind away.

Low cost network

All right, here's another idea, which I think should be looked at very seriously. In the wash-up to the New South Wales fires, it was suggested that a 'special radio station' might be established to broadcast essential information during fires. A good suggestion, but why don't we take it a step further — to a special Public Emergency Radio Network?

The basis of this already exists in the USA and possibly other places. There they have set aside a block of frequencies in the VHF communications band around 160MHz, for 'WeatherRadio'. Small communications-type transmitters are installed on tall buildings or mountain tops near towns small or large, and just about everyone in the USA is within range of a signal.

Receivers for WeatherRadio are sold very cheaply by dealers such as Tandy. Most are simple pocket radios running from 9-volt transistor batteries. They are either fixed-tuned or have a simple channel switch, and they use little extendable whip antennas.

During normal times, WeatherRadio lives up to its name with a 24 hour a day stream of continuous recorded weather information.

The system cycles through several different services read by different announcers. These include a national weather summary, a six-day forecast, a local forecast, local temperature, humidity and wind readings, and a report on road conditions in the area.

Before you go out somewhere, particularly on a snowy evening, it's a simple matter to click on the WeatherRadio for a couple of minutes to find out if the road you intend to use is still open, and what you can expect when it's time to come home. It's all good reliable information, provided directly by the National Weather Service and the local police.

In addition to the pocket radios, a more elaborate type of weather receiver is used extensively in areas prone to cyclones and tornadoes. These are mains-powered sets and they're meant to be plugged in all the time, sitting in the kitchen or some other central place. They have self-contained whip antennas and backup batteries so they keep going even when the mains power fails.

When it's necessary to issue a cyclone or tornado warning, the Weather Bureau sends it out over the WeatherRadio system — preceded by a series of audio tones. These bring the mains-powered receivers to life, whether or not the owner has 'turned them on'. Some models even take control of the volume control so that any urgent warnings come out good and loud, despite where the volume knob is set.

Now, this idea sounds like it could be easily adapted for Australia. It would be necessary to allocate the same band of frequencies used overseas, making available an instant supply of imported WeatherRadio receivers. Of course to be the most use in Australia, the network should consist not of one big station in each city, but of small transmitters to cover separate geographical areas.

During routine operation all transmitters in each state would carry the same program of weather and road information. But during cyclones or floods or bushfires, specific warnings could be directed to specific areas via their own transmitters, which would emit the tones necessary to bring 'sleeping' receivers to life.

Just imagine...

Imagine how much easier life would have been during the New South Wales fires if there had been one WeatherRadio transmitter for northern Sydney, another for southern Sydney, another for the Blue Mountains, another for Gosford, and so on. Then, if the worst happened, the authorities could simply direct a message to the Blue Mountains transmitter only, advising people to evacuate Katoomba, while not alarming people in other areas. Thus, if someone's WeatherRadio suddenly springs to life, they know the message is directed specifically to THEM, to be ignored at their peril.

Since each station is meant to cover a specific area only, transmitters can be simple VHF base station units with the receiver part deleted. Fifty watts would be plenty.

The base stations will need to be bushfire and cyclone proof, but this is not such a difficult requirement in these days of small power-efficient solid state gear. They could be enclosed in small steel boxes, mounted on metal poles with the antennas at the top. If you go bushwalking to mountaintops, you see radio stations like this all the time.

The transmitters would of course need to be on different channels so adjacent areas don't pick up transmissions not intended for them. The public, with their receivers, would need to be educated as to which channel to leave their sets tuned to, but a letterbox drop in each area would fix that.

The audio input to each transmitter could be supplied by simple low-powered UHF links, all originating from the one place. These could be controlled by the Weather Bureau at normal times, but individual links could be taken over by the fire brigades or police in the event of a natural disaster.

Now I can *guarantee* there will be many out there who will say this scheme won't work. But think about it — dead simple, eh?

Politicians will bleat 'too expensive'; in other words, there probably aren't a lot of votes in it. Better to build a new sporting facility. But all we're really talking about is a simple radio network of a few base stations, as already used by emergency services such as fire and police. The only difference is that this one is directed at the public, instead of fire trucks or police cars.

The people out there will have to each kick in say $50 for a receiver that responds to the selective calling tones, and perhaps a pocket set or two. But isn't that cheaper than watching your house burn down? ❖

Ω

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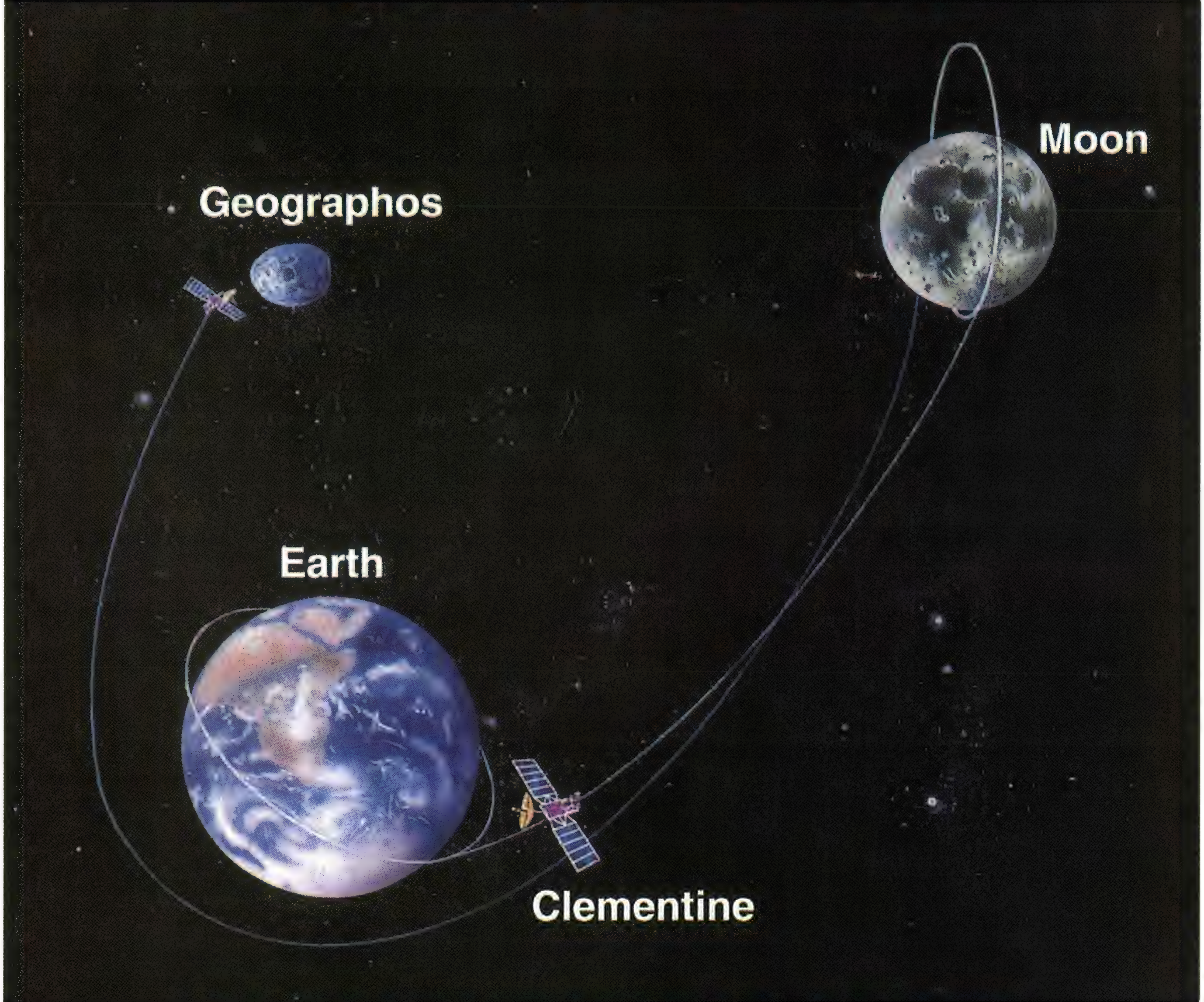
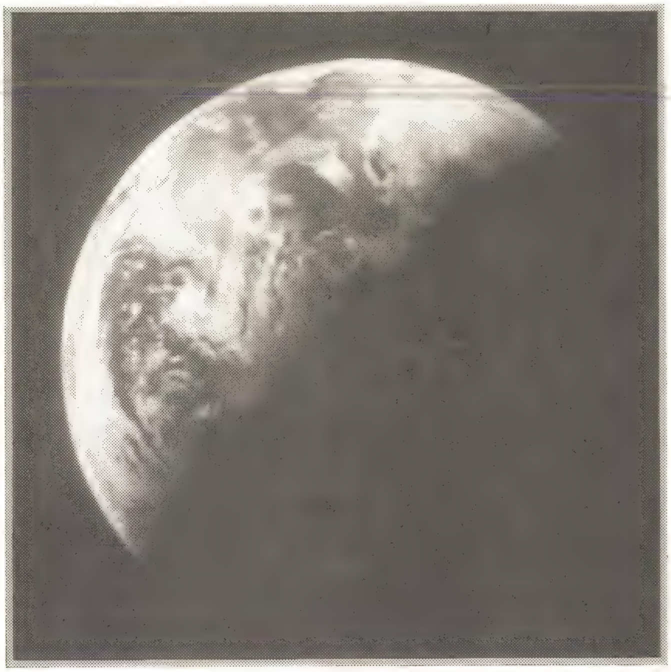


CLEMENTINE'S VISIT TO THE MOON AND GEOGRAPHOS

The US Department of Defense's Ballistic Missile Defense Organization and Naval Research Laboratory have developed a new generation of lightweight, advanced technology satellites, in cooperation with NASA. Called Clementine, the program is described as a 'low cost, fast-track' project. Its first space mission, Clementine 1, is currently in space gathering a lot of scientific information (including images) on both the Moon and the near-Earth asteroid Geographos.



Images from the spacecraft 'Clementine'. Above — Earth from 78,000km. Right — East Africa from 15,000km.

Opposite: Our lead picture shows the trajectory to be followed by Clementine from Earth orbit to lunar orbit, and then on to the asteroid Geographos. Also shown is the Earth orbit for the spacecraft booster stage, which stays behind to conduct radiation experiments using a variety of sensors. (Pictures couresy of Naval Research Laboratory.)

On 20 July 1969, astronauts Neil Armstrong and Buzz Aldrin became the first men to walk on the Moon. During the next three years, another 10 astronauts walked on the Moon, in what was hoped to be preparation for a longer duration stay which would eventually involve lunar settlements by the year 2000.

These ambitious plans were scrapped when the Nixon administration, after the success of *Apollo 11,* drastically cut the budget of the National Aeronautics and Space Administration (NASA) — limiting the Apollo program to a further six flights.

Following the completion of the Apollo program in December 1972, NASA scrapped all of the Apollo hardware and placed any further plans for lunar exploration on the backburner until well into the next century.

It was not until 1980 that another lunar mission was suggested. Scientists at the Jet Propulsion Laboratory (JPL) located in Pasadena, California proposed the Lunar Polar Orbiter (LPO), which would have a price tag of US$400 million and would be launched in the mid to late 1990's. But after a decade of design changes and schedule slippages, the LPO program was cancelled in 1990.

Hope that the United States would go back to the Moon briefly surfaced during the celebrations of the 20th anniversary of the *Apollo 11 flight,* in July 1989. During a speech at the National Air and Space Museum in Washington DC, then President George Bush declared that the US should return to the Moon and have humans on the planet Mars by 2019 — the 50th anniversary of the *Apollo 11* flight.

Several high level reports commissioned by both NASA and the White House suggested a human return to the Moon take place by 2004. However these plans did not gain the support of Congress and there were serious doubts raised about NASA's abilities to carry out such an ambitious program, which led to any plans for lunar exploration again being placed on the backburner.

Another player

In September 1990, however, another player entered the picture in the form of the Strategic Defence Initiative Organisation (SDIO). Responsible for implementing the 'Star Wars' program, the SDIO had developed lightweight and miniaturised sensors that were capable of hunting fast-moving objects in space. During that same month, the then Deputy Secretary of Defense Donald Atwood received a letter from then NASA Administrator Dick Truly, inquiring about the use of SDIO technologies for low cost planetary missions.

Under the terms of the Anti-Ballistic Missile Treaty signed in 1972 by both the United States and Soviet Union, it would have been illegal for the SDIO to test the sensors that they had developed in Earth orbit. So after six months of study, SDIO in cooperation with NASA decided on a flight to a near-Earth asteroid, 1620 Geographos. This interested SDIO scientists, because it would use a natural celestial body against a deep space background, at a realistic approach target of 11 kilometres per second. The flight also interested NASA scientists as it would give them an opportunity to examine an asteroid in closer detail than the *Galileo* spacecraft had done (see *EA*, May 1993), with the asteroids Gaspra in 1991 and Ida in 1993.

In late 1991, a two-month lunar mapping program was added to the flight, as SDIO scientists decided that the Moon would make an excellent target to determine the sensitivity of the spacecraft's camera and scientific instruments — as well as providing a further 'bonus' for planetary scientists. Since the end of the Apollo program, no American spacecraft had flown to the Moon except the *Galileo* spacecraft, which had made brief Earth/Moon flybys in December 1990 and December 1992.

In January 1992, after the addition of the lunar mapping phase, the SDIO informed NASA of their intention to fly the first Deep Space Program Science Experiment (DSPSE) spacecraft — which was christened *'Clementine'.* Since one of *Clementine's* goals was to determine the mineral content of both the Moon and Geographos, the spacecraft was named after the Californian

by KATE DOOLAN

gold miner's ballad 'My Darling Clementine'. As in the song, *Clementine* will be 'lost and gone forever' after the Geographos encounter...

The *Clementine* mission was dedicated to the memory of space scientist and visionary Dr Gerard K. O'Neill (1927-1992), who designed and advocated plans for large human settlements in Earth orbit.

Clementine's vitals

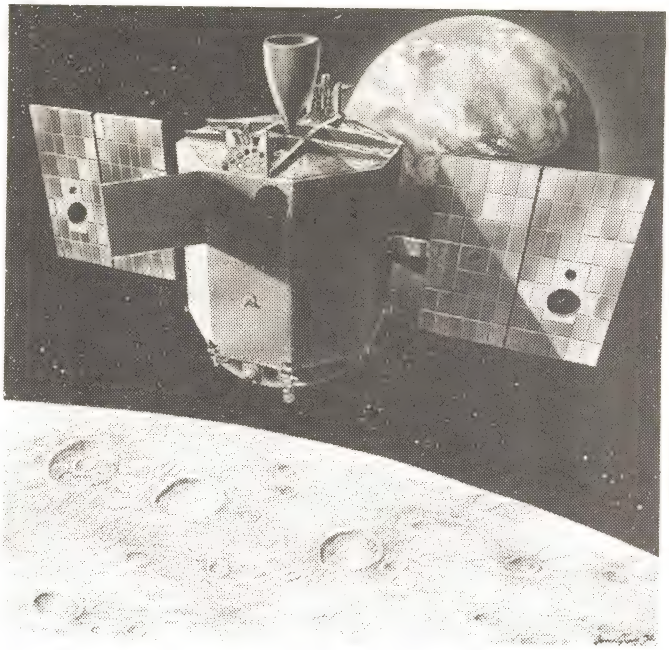
The *Clementine* spacecraft weighs 424 kilograms fully fuelled, and the whole spacecraft configuration — which contains a launch adaptor, solid rocket motor and *Clementine* — weighs only 1690kg, making it one of the lightest scientific spacecraft ever launched. *Clementine* measures only 1.14 metres in diameter and 1.88m in length. To communicate with Earth, the spacecraft has a fixed 1.1m high-gain antenna.

Clementine contains monopropellant hydrazine for attitude control, and bipropellant nitrogen tetroxide plus monomethyl hydrazine for changes in the spacecraft's speed. The bipropellant has the capacity of 1.8km/s, with 550m/s needed for insertion into lunar orbit and 540m/s required for departure from the Moon. The remaining fuel will be used for changes in the spacecraft's speed, maintenance in lunar orbit, error correction and the Geographos flyby.

Two advanced technologies have been introduced in the spacecraft's electrical power system. A common pressure vessel 15 ampere-hour nickel-hydrogen battery is being used for the first time on a spacecraft. This form of battery is the preferred mid- term solution for high energy, low volume mass and high cycle life requirements. At 47 watt-hours per kilogram, the battery has double the energy per unit mass of previously flown batteries.

In addition, the *Clementine* spacecraft has one of the lightest solar arrays ever used on a spacecraft. The solar panels measure 2.3m^2 and generate 460 watts of power. With a power density of 301 watts per square metre, the thin 0.0055" gallium arsenide/germanium solar cells have 100% more power output than the commonly used silicon cells.

Two advanced lightweight technologies have been incorporated into the spacecraft's attitude control system (ACS). *Clementine* has two light inertial measurement units developed by SDIO scientists — a 500 gram ring laser gyroscope and a 500 gram interferometric fibre optic gyroscope, which maintain a drift rate of 1° per hour.



Although it may look almost as large as the Earth in this artist's impression, Clementine is actually quite small: it's only 1.88 metres in length, and 1.14 metres in diameter.

Another first for *Clementine* is the orbital flight qualification of the two-kilogram Bell Aerospace lightweight reaction wheels. The drive electronics are integrated with the wheel assembly and use an average of only 9W of power.

JPEG imaging

Another instrument that is being flight qualified by *Clementine* is the computer processing system (CPS). In addition to a Military Standard 1750 16-bit processor used for routine spacecraft operations, *Clementine* uses an off-the-shelf 32-bit RISC (reduced instruction set computer) processor which is used for imaging data from the scientific sensors. A JPEG (Joint Photographic Export Group) chip set from Matra Marconi is being used to compress data from the spacecraft's sensors for storage in the solid state data recorder, before transmission back to Earth. By this qualification of JPEG, the image compression technology can be used in future NASA and Department of Defense spacecraft.

During the mapping of the Moon and Geographos, the computer processing system stores data in a 2GB (gigabyte) solid state data recorder (SSDR) which has four times the capacity of previously flown data recorders. The SSDR was designed for high reliability, uses redundancy error detection and correction with fault management and has a built-in test program.

The SSDR weighs 3.4kg and uses commercially available 4Mb DRAM (dynamic random access memory) chips. It has a data throughput greater than 20 megabytes per second, with a bit error rate of less than one part in ten billion.

Array of sensors

The sensor complement that is being flown on *Clementine* includes an ultraviolet/visible imaging camera, a Near Infrared Camera, a Long Wave Infrared Camera and a Laser Image Detection and Ranging high resolution imaging system. Pointing information for both the spacecraft and its sensors is provided by an onboard system using two 'wide field of view' star trackers. All of the instruments were designed by the Lawrence Livermore National Laboratory in California. A Charged Particle Telescope built by the Aerospace Corporation has also been included with the sensor payload.

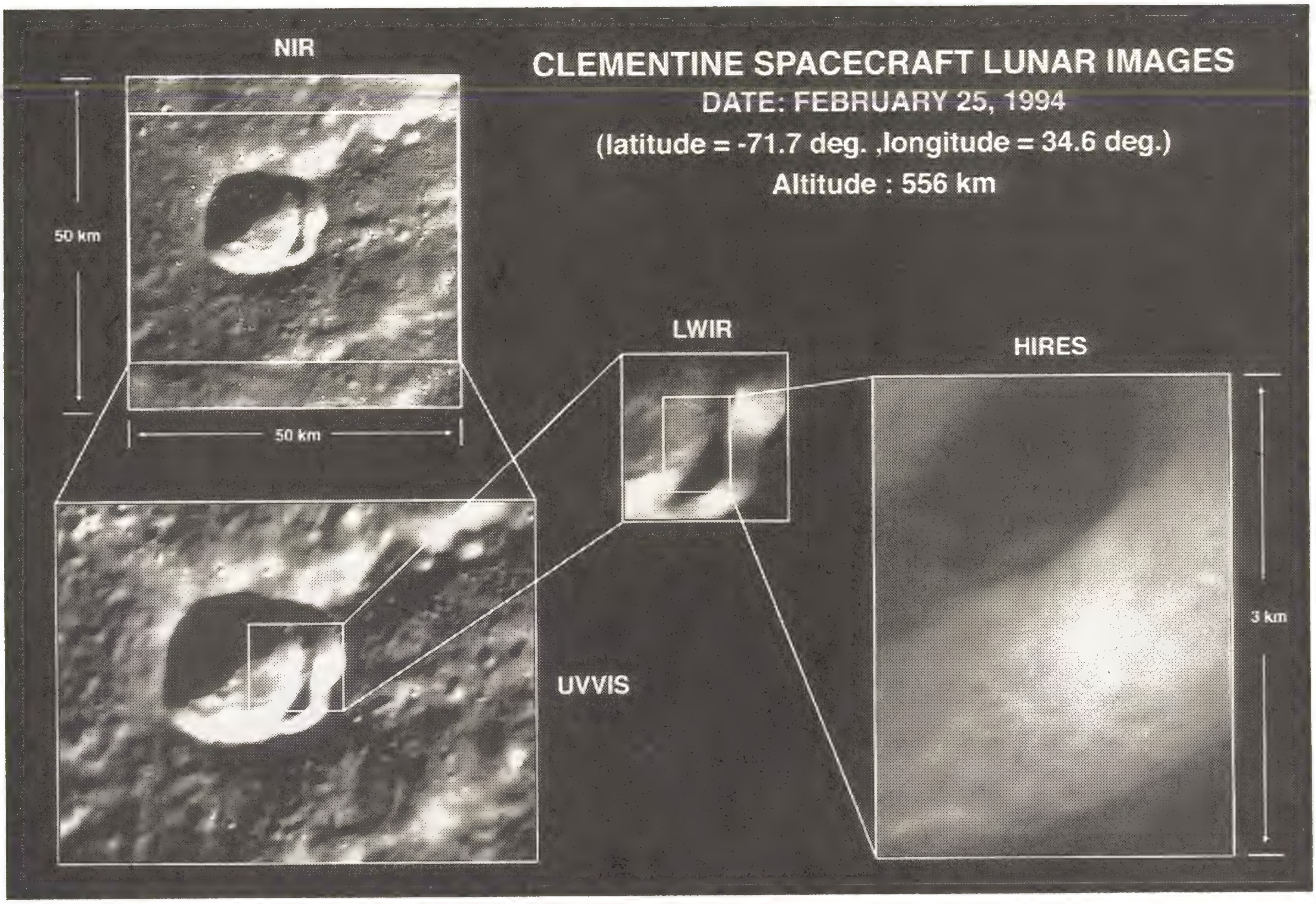
The ultraviolet/visible imaging system is a CCD (charge-coupled device) camera that weighs 500 grams and measures 105 x 120 x 160mm. This camera is capable of taking 10 images per second and has been designed for inexpensive manufacture and calibration. Ultraviolet sensors that are on current spacecraft in orbit are two to four times heavier, require three times as more power and are more expensive.

The camera has a modular filter wheel with six positions, five of which give narrow-band filter wavelengths of 310, 645, 795, 845 and 895 nanometres. The sixth filter is a broad-band filter with a wavelength of 295 to 845nm. The field of view is such that a 425km orbit has a cross track width of approximately 50km.

This field of view, combined with a five hour elliptical orbit of the Moon, allows complete mapping coverage during *Clementine's* two month visit. During a single orbit of the Moon, the pixel resolution varies from 125 to 325 metres.

At Geographos, the pixel size will be 25 metres at a flyby distance of 100km. Geographos is an elongated asteroid estimated to measure two kilometres by four kilometres, therefore the image at the closest approach would be about 80 pixels across the short axis.

The Near Infrared Camera (NIC) weighs 1.6kg and has a mechanically cooled 256 x 256 pixel indium antimonide focal plane array, with a bandpass from 995 up to 2695nm as well as again having a filter wheel with six positions. The filter wavelengths are in this case 995, 1145, 1395, 1895, 2495 and 2675nm. The field of view for the NIC camera is similar to that of the ultraviolet/visible camera, so complete lunar mapping coverage can be


CLEMENTINE SPACECRAFT LUNAR IMAGES
DATE: FEBRUARY 25, 1994
(latitude = -71.7 deg. ,longitude = 34.6 deg.)
Altitude : 556 km
NIR
50 km
50 km
LWIR
HIRES
3 km
UVVIS

achieved in two months. The characteristics of the focal plane array are such that the individual resolution will vary from 200 to 400 metres at the Moon down to 40m at Geographos.

The Long Wavelength Infrared Camera (LWIR) weighs 1.65kg and measures 150 x 150 x 400mm, with a power requirement of 30 watts. The LWIR will be primarily used for thermal sensing, which will be important during the Geographos flyby as the spacecraft will be approaching the asteroid from its dark side.

LWIR has a 128 by 128 pixel mercury-cadmium-telluride focal plane array, which is mechanically cooled and has a broadband response of 7895 to 9395nm. The 1° x 1° field of view results in a ground footprint of 18.3 by 18.3 kilometres, at a spacecraft altitude of 1000 kilometres with a pixel resolution of 100 metres.

The Laser Imaging Detection and Ranging (LIDAR) system has an active ranging system as well as a passive imaging capability. The LIDAR system weighs only 1kg and measures 40 x 100 x 220mm.

As well as being portable, the LIDAR system has many military and civilian applications. Its laser is a diode pumped Nd-YAG type, pumped at 1.064 microns with a pulse rate of 180 joules every 10 seconds. The laser transmitter has a wavelength for ranging and the ranging capability has a vertical bin size of 40 metres to a distance of 500 kilometres, depending on the brightness and the surface roughness.

Altimetric data for the lunar surface is collected when *Clementine* is below a 500 kilometre altitude, providing a topographic database between the latitudes of 60° north and 60° south.

High resolution optics and a signal intensifier permits the LIDAR system to have a pixel resolution of between 10 and 30 metres during the lunar mapping phase and better than five metres during the Geographos flyby. LIDAR's field of view is small, so only selected areas of the Moon will be covered by the sensor — primarily due to onboard memory constraints.

The LIDAR system also has a filter wheel, with a broadband filter from 295 to 695nm as well as narrowband filters at 310, 455, 545 and 645nm.

The Charged Particle Telescope (CPT), which weighs only 200g (the equivalent of a family block of chocolate!) measures the flux and spectra of ions and electrons with energies exceeding 30,000 electron volts. The CPT measures electrons in five energy channels, from 30,000 electron volts up to 1MeV. Protons are also measured, in two energy channels from 10 to 80MeV.

The CPT will also be measuring the fluxes and spectra of energetic electrons and protons throughout *Clementine's* mission. The electron channels will provide data on the interaction of the Moon with the Earth's magnetotail. The CPT can also observe energetic electron flows during magnetic storms, as well as interplanetary shocks and their interaction with the Moon.

To evaluate the effects of the space radiation environment on the advanced microelectronic systems and components on *Clementine,* several radiation measurement devices are being flown. These devices include four solid state dosimeters, a single event upset/total dose recorder as well as other monitoring devices.

The interstage adaptor, which is being left in a highly inclined Earth orbit of 200 x 160,000km for 450 days, has also got a package of radiation experiments to allow comparative measurements from the *Clementine* spacecraft.

Clementine has two star tracker cameras, weighing 370 grams and measuring 120 x 120 x 140mm, which have been integrated into the spacecraft. The star trackers are miniaturised 0.1 - 0.3 millirad optical sensors, which perform a three-axis determination with one starfield image. The wide 29° by 43° field of view minimises the star catalog by only using the brightest stars.

The tracker focal plane array is a silicon CCD operating between 0.4 and 1.1 microns, with a pixel size of 23 x 23 microns. The f/1.28 design has a 14.4mm aperture with a 17.7mm focal length, and the electronics operate at a maximum frame rate of 10Hz via an analog/digital converter.

Clementine's Visit to the Moon and Geographos

Communications links

Clementine communicates with ground controllers at the Naval Research Laboratory in Alexandria, Virginia via NASA's Deep Space Network (DSN). The DSN is a complex of large antennae and transmitters located in Goldstone, California; Madrid, Spain and Australia's Tidbinbilla in the ACT. The DSN is then linked to a network control centre at the Jet Propulsion Laboratory.

During its short stay at the Moon, *Clementine* returned up to 5000 digital images for each lunar orbit it made. To store this information, compact discs are being used so the information can be freely made available to anyone who wants to purchase them. It is expected that a complete set of *Clementine* data will cost less than US$300. In another first, the SDIO Office is making the information available on the Internet computer network (Clementine.S1.gov), where bulletins can be read and the imagery can be downloaded.

Another innovation is the management and construction of the spacecraft. It took only 22 months for 55 staff at the Naval Research Laboratory (NRL) to design, develop and construct *Clementine*. There were none of the usual bureaucratic obstacles common to most NASA and military space programs, as the funding from the SDIO Office was given directly to the NRL. More time and money was saved when there was no middle management or advisory teams used.

The total cost for the *Clementine* mission was US$75 million, which included the price of the launch vehicle. By comparison, the *Galileo* mission has cost over US$1 billion, and the recent Hubble Space Telescope repair mission was US$650 million.

A few problems

Several problems were encountered during *Clementine's* construction, with the Long Wavelength Camera and Near Infrared Camera failing vibration testing. This meant that both cameras had to be rebuilt, delaying their delivery to the NRL by three months. The LWIR camera also had encountered difficulties in the cooling process, but these were solved before launch.

By the time that the scheduled launch date of January 1994 had rolled around, one important change had been made. After coming to office, the Clinton administration had cancelled the more esoteric plans of the SDIO Office and they were told to concentrate on Earth-based missile technologies (such as the advanced 'Patriot' missile). To reflect this change, the SDIO Office had been renamed the Ballistic Missile Defense Organisation (BMDO). As the *Clementine* mission had been so far along in its planning, the BMDO Office continued with the management responsibility for the spacecraft.

In the month before the launch, the *Clementine* spacecraft was moved outside to allow the star trackers to make observations of the stars. During these tests, an error in the software code was found which produced an alignment error in one of the star trackers. This error was promptly repaired.

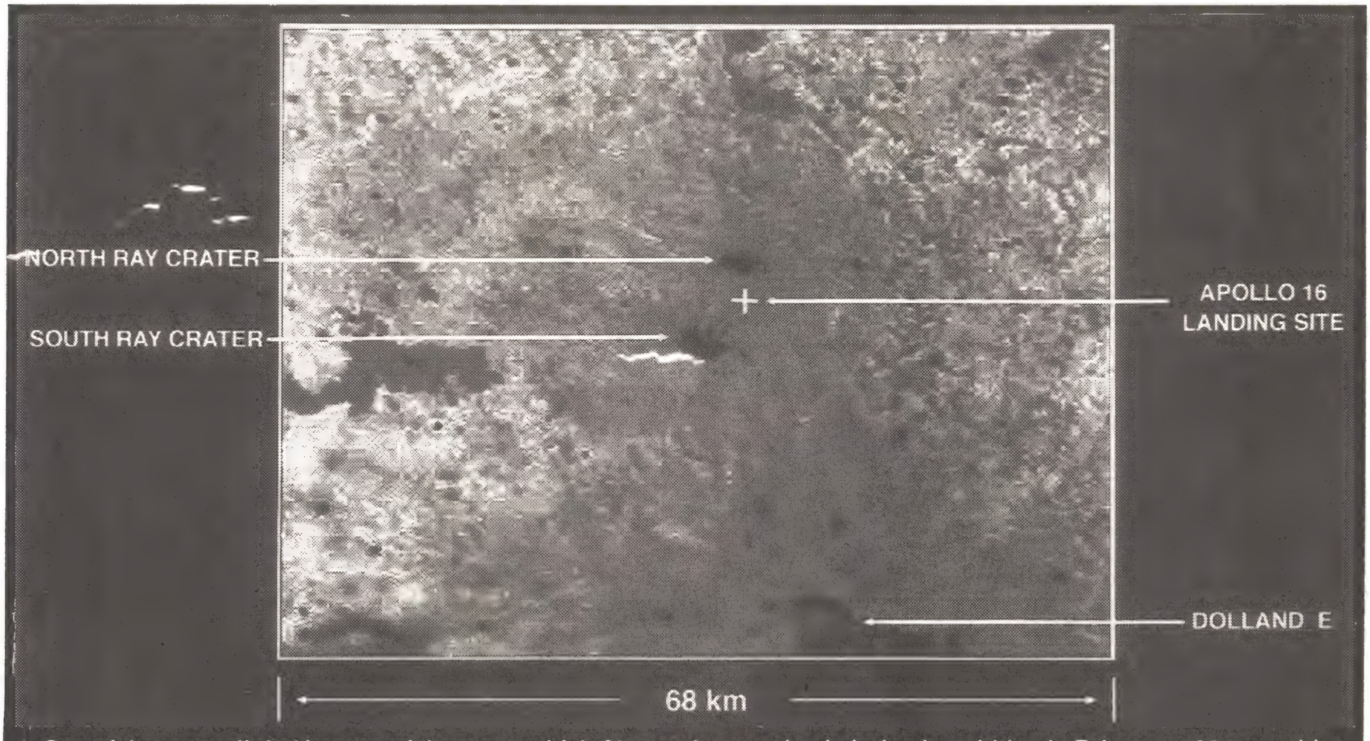
Unlike most launch vehicles that are used for robot spacecraft, *Clementine* was launched on a Titan IIG rocket, which was not brand new. The Titan IIG used had spent the previous 25 years as an Intercontinental Ballistic Missile, in a silo not far from Little Rock, Arkansas and had been refurbished for the *Clementine* launch. The Titan IIG has been used by the US space program both civil and military since 1959, most notably for NASA's *Gemini* manned flights between March 1965 and November 1966.

January launch

Clementine was launched from the Vandenberg Air Force Base in California at 8:34am (local time) on 25 January 1994. Normally the Cape Canaveral Air Force Station (next to the Kennedy Space Centre) in Florida would have been used for the launch, but the Titan IIG pad was demolished in the seventies. The launch was routine, with no serious problems reported.

The day after the launch, a Thiokol 37FM solid rocket motor fired placing Clementine into a temporary orbit of 140 x 160km. Several days later, the spacecraft was manoeuvred into an eccentric 'phasing' orbit which ranged from several hundred kilometres above the Earth to several hundred kilometres from the Moon. The 'slow boat' route to the Moon gave the spacecraft a seven day launch window, and lowered fuel requirements for insertion into lunar orbit.

Clementine entered lunar orbit on 19 January 1994 and after a short checkout period, began to map the Moon. At a press conference in March 1994, images of the



One of the many digital images of the moon which Clementine sent back during its orbiting in February 1994 was this photo of the Apollo 16 landing site, viewed from an altitude of 495 kilometres.

Moon were displayed and some of the images displayed of the far side of the Moon showed a detailed resolution that had not been possible previously — even during the Apollo program.

On 3 May 1994, *Clementine* was due to perform a manoeuvre to allow an Earth flyby and to place it into an Earth phasing orbit. At the end of this three-week phasing orbit, the spacecraft was to perform a course correction which included another lunar flyby and gravity assist before departing for Geographos.

Geographos will have its closest approach to Earth in late August 1994. Soon after its closest approach, the asteroid will cross the plane of the ecliptic where on 31 August, *Clementine* will fly by Geographos at a velocity of 11km/s. The actual flyby distance is to be determined, but it is expected to be approximately 100 kilometres — at which distance the spacecraft may be able to track the asteroid continuously during the flyby. The data recorded during the flyby will be stored on board for later playback to Earth.

During the cruising phase from the Moon to Geographos, it is possible that *Clementine* may be used to observe Jupiter during the week of 15 to 22 July. During this time, the Comet Shoemaker/Levy is expected to collide with Jupiter and scientists will be using an armada of spacecraft to observe this event. The BMDO office and NASA had discussions during late January, but nothing has been publicly announced.

Although *Clementine* is a perfect example of a low cost scientifically effective spacecraft, there are doubts about any successors being built. With the BMDO Office being taken out of the space business, NASA have stated no desire to have the *Clementine* series of spacecraft under their control as it would compete with their Discovery program — which promises to build and launch planetary spacecraft for under US$150 million in three years. Congressman Dick Zimmer has legislated that the *Clementine* program be placed under control of the US Navy. The transfer of *Clementine* to the Navy has not included funding past this year, but it is hoped this will change as there are plans to use other *Clementine-type* spacecraft to fly to other asteroids — where they will be using ballistic missiles to impact on their surfaces so their mineral content can be studied. It is also hoped that *Clementine 1* will receive enough funding for a flyby of the asteroid 1983RD in October 1995.

The *Clementine* program is an example of what is needed in times of decreasing space budgets around the world, so hopefully the program will not be 'lost and gone forever' after the Geographos flyby.

In closing, the author wishes to thank Dwayne Day of the Space Policy Institute, Mary Hardin of the Jet Propulsion Laboratory, Louis Kourtidis and Richard Tonkin for their assistance in the completion of this article. The photographs are reproduced courtesy of NASA and the US Department of Defense. ❖

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Do-It-Yourself Radio Astronomy — 1

JUPITER SQUAWKS!

Radio astronomy is a field that most readers wouldn't have dabbled with. Too hard, you say — you've got to have a monstrous dish antenna and all kinds of fancy equipment, and anyhow it's all been done before, right? WRONG, on all counts! Chances are you already have all the equipment you need to do the experiments described in this first article, and in future instalments we will use equipment that's either easily built, or diverted from other less esoteric duties...

by TOM MOFFAT, VK7TM

Usually when I prepare a series of magazine articles, all parts of it are complete before the first article appears in print. But this time around, I must confess that it was necessary to take the plunge with only this first part finished; the others are still under development. My excuse is that I wanted to get this one into the July issue of *Electronics Australia*, before the world ends.

Aha — I bet I've got your attention now! Yes, friends, it's 'worlds in collision' time, on or about July 21. A comet named Shoemaker-Levy is heading straight for the planet Jupiter, breaking into fragments as it goes. These fragments are predicted to slam into Jupiter over a period of five or six days, with the biggest impact predicted for 8:00pm on July 21.

This is convenient for us here in Australia because at that time Jupiter will be high in the night sky, 54° above the horizon on a heading of 323°. Those figures are for Hobart; the rest of Australia should be pretty close. However Jupiter will NOT be visible in the highly populated areas of America and Europe. What a pity, it looks like we've got it on our own!

So what will happen when the comet collides with Jupiter? Nobody knows; such a thing has never before happened in recorded history. Maybe Jupiter will explode, showering the rest of the solar system with burning methane. Or maybe the bits of comet will just go 'plop' in Jupiter's atmosphere and that will be the last of it.

The important thing is that this has never happened before — and WE will get to watch it, with our eyes and with our radios. So now is the time to bone up on some radio astronomy lore.

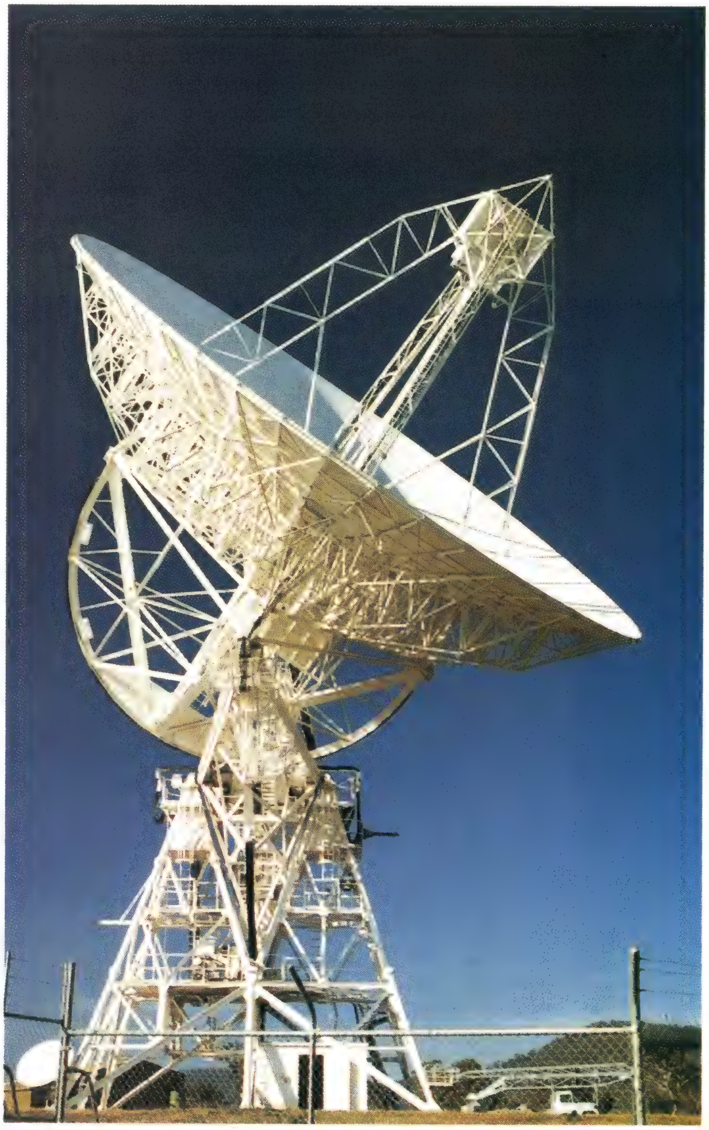


Fig.1: The Mount Pleasant radio telescope, near Hobart in Tasmania. The dish is 29 metres in diameter.

Why RADIO astronomy?

What you can see with your eyes when you look up to the sky is only a tiny part of what's there, because it is only the VISIBLE part of the spectrum. Radio waves are made up of the same stuff as light, only on a lower frequency (longer wavelength). On the other hand, X-rays are made up of the same stuff as light, only on a higher frequency (shorter wavelength).

To restrict one's observations to visible light is like listening to good music on a little transistor radio. You recognize the tune, but it doesn't sound very good because you're getting the midrange frequencies only. Adding radio and X-ray observations is like playing the music on a big hi-fi system; you're getting all the information being transmitted, the full range of the spectrum.

When you LOOK up into the sky, you only see VISIBLE objects. Other objects emit no light at all, but instead emit radio signals. If we didn't LISTEN for the radio-emitters, we would never know they were there. Other space objects emit only X-rays, with nothing on radio or visible frequencies. Some objects emit on all the frequencies at once. But if we only dealt with celestial objects we could SEE, many secrets of the universe would remain hidden forever. You are now allowed to say "Gee whizz"!

We won't be messing around with X-ray astronomy; that's definitely in the too-hard basket. We'll leave X-rays to space shuttles and the like. But as for radio astronomy, all we need in the first instance is a radio receiver, an antenna and possibly a tape recorder — things that just about every reader will have access to. This will allow us to receive some signals from Jupiter, which might prove very interesting as it gets pounded by a comet. We can also listen for radio emissions from the Sun.

The next article in this series will (hopefully) describe a gadget that will turn a personal computer into a simple chart recorder, for displaying radio astronomy observations in graphic form. I've got the software for this working in 'model' form and an interface has been designed, but not tested. I had to push it all aside to get this article out.

Later on we might look at some radio astronomy techniques at higher frequencies, which should extend our activities from our own solar system out into the galaxies.

Author Tom Moffat (right) pictured with radio astronomy pioneer Grote Reber, who nowadays lives in Bothwell — about an hour's drive from Hobart.

How it all started

Two names pop up in every discussion on radio astronomy: Karl Jansky and Grote Reber. In the early explosion of interest in radio signals from space, I guess it would be fair to say that Karl Jansky lit the fuse and Grote Reber threw the firecracker. Jansky is long gone, but Grote Reber is still living as quite a man-about-town in Bothwell, Tasmania — about an hour's drive from Hobart. Mr Reber has graciously offered his full assistance in the preparation of this series, so you're going to be hearing a lot from him.

Jansky was the first to observe radio signals from space, through a combination of curiosity and good luck. Back in 1932, he was supposed to be working on a 'government job', studying the source of atmospheric static that disrupted radio communications. But he kept getting waylaid by strange results — signals that appeared in the sky, and then moved. Grote Reber, who knew Jansky well, describes in his own words the discovery of the first celestial radio source:

"It came up in the east at dawn, it went through south near noon, and it disappeared into the west in the evening. And he (Jansky) writes his first paper and says that's probably caused by some kind of radiation from the sun, but he doesn't think it's directly from the sun; he thinks it's something that's generated in the earth's upper atmosphere by particles from the sun."

"But then there's a footnote that says that this hypothesis of it coming from the sun is wrong, because it no longer follows the sun — it's now six hours earlier, it comes up at midnight. And so he had to have another explanation."

"So, he keeps making observations. And he's supposed to be finding the direction of arrival of atmospherics; that's his job, see. So, this is where the luck is. Now most people, if given a job of finding the direction of arrival of atmospherics, that's what they DO. And this small background that he found would be ignored. But Jansky was a person who apparently had considerable curiosity. And the job he had had plenty of spare time in it. So he undertook to find the source of these small backgrounds."

"See, this was luck, getting the right man at the right place at the right time doing the right thing. And it was all there. And so we had a discovery. But if any one of those ingredients was missing, there wouldn't be any discovery."

Grote Reber himself took Jansky's discovery and built on it, making observations on different frequencies. As he went higher he noticed what we all know now, that the higher frequencies contain less energy. So it is necessary to concentrate the energy into an antenna, just as the mirror of a reflector telescope concentrates light energy into an eyepiece. A big radio mirror, huh? Well why not — and Grote Reber proceeded to build one.

This whopper was nine metres in diameter, with full elevation and directional control, and it was the world's first 'parabolic dish' antenna. It was the ancestor of all those satellite dishes you see on top of pubs and in people's backyards. Nowadays a three-metre dish, fixed in place and not steerable, would be about the best a back-yarder would hope for. Grote Reber's dish would have been three times that size, probably about as big as his house. I'll bet his local council had kittens when they saw it...

Fig.1 shows a modern radio telescope which follows almost exactly the original Reber design, except at 29 metres in diameter it's three times bigger again. This dish is located not far from Hobart airport, and many people who have flown into this fair city would have noticed it out the right side of the aircraft just before landing. In fact the dish is used as an unofficial landmark by pilots, who report "I've just passed the radio telescope".

The facility is officially known as the Mount Pleasant Observa- tory, owned by the University of Tasmania. The dish itself was donated by NASA, which used it in the deep-space program. It's of 1960's vintage, but in as-new condition, and it even came with some 1960's electronics such as a lovely old Ampex FR-series data recorder which is still used.

The arrival of this dish caused the local council, and the residents, to have hysterics. The thing looked so technological that everyone assumed it was obviously dangerous.

Residents of the nearby 'historical site' town of Richmond feared that they'd be sizzled off the face of the earth if the University ever accidentally pointed the dish at them. But the local populace was eventually convinced that the thing was 'receive-only', and the radio telescope has led a quiet and useful existence ever since.

'Quiet' is the magic word here. The Mount Pleasant site (aptly named) is on a small knoll about 100m high, overlooking farmland and the airport and the sea. So it's far removed from any power lines or other sources of man-made noise. There's even a hill to the west that blocks the line-of-sight radio path from Mount Wellington, the home of many powerful TV and FM transmitters and other sources of radio noise.

Fig.2 shows the console that controls the movement of the dish. You can punch in your desired direction and elevation coordinates and hit the 'go' button, and the electronics in the console will move the dish to point in exactly that position. It will then cause it to track the object being observed, as it compensates for the earth's rotation.

What kind of objects? Well, *pulsars* for starters. Pulsars are believed to be spinning objects in space that are 'squeezed' electromagnetically, so that they can only squirt out a thin beam of radio energy — like the light beam from a lighthouse. We hear the beam going flip-flip-flip as it passes the earth, or a buzz if it's spinning faster.

A recent news report told of the discovery of a pulsar that was emitting a tone suggesting a spin rate of something like 14,000rpm. This is for a star-sized object — imagine the centrifugal force that should be pulling it apart. So there must be a larger force holding it together. Such are the things discovered by radio astronomy.

The Mount Pleasant radio telescope uses 'receivers' mounted at the focus of the dish. These are really low noise amplifiers (LNA's in current satellite-dish jargon) which pre-amplify signals and then convert them down to an intermediate frequency for transmission to the control building.

Seven frequency bands are catered for; 600, 843, 1400, 2300, 6600, 8400 and 12,200MHz. To change bands it is necessary to go to the focus of the dish and physically change the LNA. A 'cherry-picker' truck is kept nearby for this purpose. The LNAs for bands above 2000MHz are cooled with liquid helium down to -250°C. THAT'S what you call a quiet receiver.

It should be noted that the radio telescope doesn't produce an *image* as such, like in an optical telescope. it's simply a very directional radio receiver. To produce a radio 'picture' of the sky, with height and width, it is necessary to scan the antenna across the desired area, noting the intensity of signals in relation to position.

Signals from the dish are fed to the racks of equipment shown in Fig.3, back in the control building. There are instruments here to cater for just about any observation a radio astronomer might want to make on a signal. And this equipment, along with the direction-control console in Fig.2, can study point sources or produce scanned images.

We won't attempt to detail all the equipment, but somewhere in that stuff must be modern equivalents of a detector and an integrator and a chart recorder, the instruments we will be using in our backyard experiments.

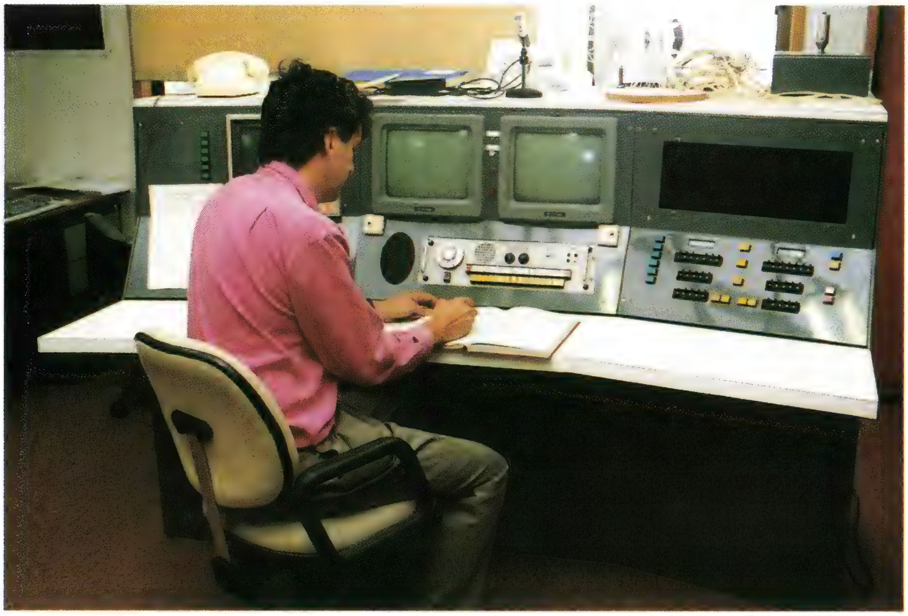


Fig.2: The control console for the Mount Pleasant radio telescope. From here the exact pointing direction of the telescope can be programmed.

Backyard astronomy

Do-it-yourself radio astronomy can involve equipment from the very simple, to extremely elaborate and expensive. The most sensible approach is to start with simple equipment, and if you find radio astronomy takes your fancy, build up from there.

You may already have everything you need to take the first steps into radio astronomy. We will describe two experiments here, involving the Sun and Jupiter. Here's what you need:

For the Sun:

- A standard FM broadcast receiver (good) or a VHF scanner or amateur two-metre rig (best).
- A television antenna with reasonable gain (good), or a multi-element Yagi or quad antenna for the 2m amateur band (best).

For Jupiter:

- A decent-quality shortwave receiver. MUST be reasonably sensitive in the range of 20 to 24MHz.
- Whatever shortwave antenna you are using now (good) or a purpose-built dipole dimensioned to resonate at 22MHz (best).

For every radio astronomy application, you will need some means of displaying your results. These can be your ears (not bad for starters), a voltmeter and a pen and paper (better), or a chart recorder (best).

Almost every emission from space manifests itself in the receiver as noise of some kind. This was misinterpreted as 'atmospheric static' before Karl Jansky came along. But since it is noise, you can hear it, and make some judgments as to its nature.

The strength of the noise is important, as is the way it varies over time. So we can use a voltmeter to take periodic readings of the noise from the receiver, perhaps measured at the speaker terminals or headphone socket, and then write the figures down on paper. Later we can make a graph showing the strength of the noise plotted against time. For slow moving events, such as solar observations, this low-tech method is quite practical, although time consuming.

A chart recorder can be used to automate the recording and graphing process. It is nothing more than a DC voltmeter and some kind of mechanism to keep a strip of paper moving lengthwise beneath a pen. The pen, in turn, can move crosswise, with its position across the paper determined by the input voltage at any instant. As the paper moves the pen draws the familiar 'wiggly line'.

The speed at which the paper moves beneath the pen can be varied to suit the application. In the case of Sun observations, it might be appropriate to record a whole day's activity from sunrise to sunset. In this case the paper might move no more than a couple of centimetres an hour. But Jupiter's emissions vary quickly, so a more useful speed might be a couple of centimetres a second. In a traditional 'pen and paper' chart recorder there is usually some kind of a gear arrangement that you can manually change, like the transmission of a car.

Mechanical chart recorders are expensive precision instruments, probably beyond the range of the average experimenter. But as mentioned above, a computer-based chart recorder is currently under development as an *Electronics Australia* project. This device displays a 'paper chart' on the screen of the computer, moving it along from right to left as the 'pen' draws a line on the right side. The 'chart' thus presented is a graph of observed voltages with the 'time line' drawn from the left to the right side of the paper.

As with my other projects, like the Listening Post II computerised weather fax recorder, every effort is being made to make the screen display look just like its mechanical equivalent. With the chart recorder there are even 'sprocket holes' at the edges of the paper, so you can see it moving even if the data being recorded results in a flat line.

In a mechanical chart recorder the paper eventually comes out of a slot in the side, so it can be rolled up and stored away. But since the computerised version doesn't use any paper, there's nothing to come out. Instead the observed values are stored away in a computer data file so that they can later be plotted on the screen 'paper' for detailed study. The completed chart can be scrolled back and forth to study areas of interest. It is also planned to provide for printing the charts on paper if desired.

With the computerised chart recorder it's easy to program just about any desired chart speed, without all those messy gears. The fastest speed is limited by how fast the computer can process and display the data and slide it along the screen. The experimental version can run at a bit over 5cm/second on the screen of a Toshiba notebook computer. Grote Reber saw this working and declared it 'fast enough' for radio astronomy. Lower speeds are determined by time delays and can be anything desired — a whole day to cross the screen, if need be.

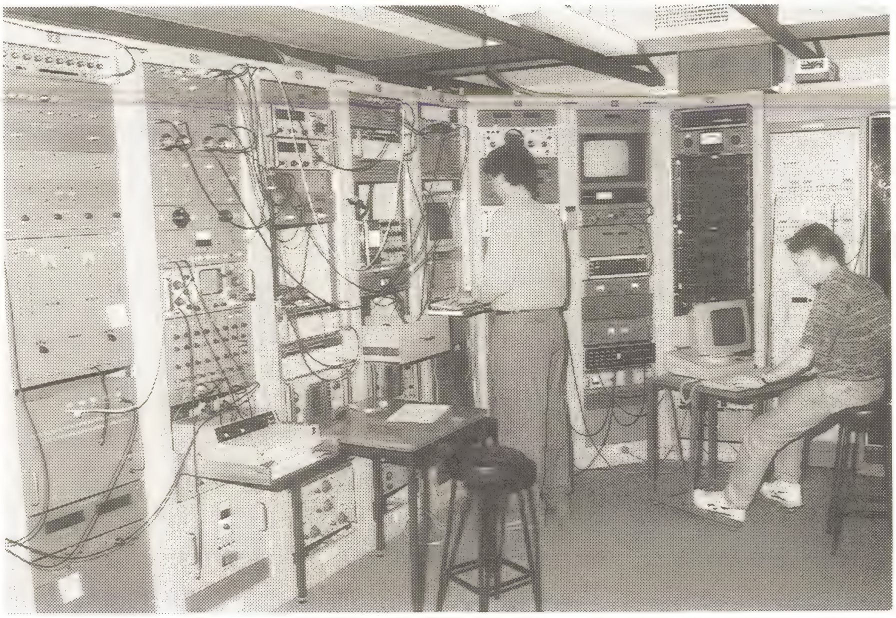


Fig.3: Some of the equipment racks at the Mount Pleasant observatory. Don't be put off by this array of equipment — you can carry out quite rewarding basic radio astronomy with much simpler equipment, as Tom Moffat explains.

The 'voltmeter' part of the computerised chart recorder is an interface that plugs into the back of the computer. This is still being worked on at the time of writing, and it will be available as a kit when the project is published in *EA*, hopefully in the next couple of months.

Audio to DC

A couple more radio astronomy essentials: what comes out of the receiver is audio; hiss and snaps and crackles. The chart recorder, or voltmeter, requires a DC representation of the strength of the audio. So we must have a way to change the audio into DC, and then smooth out its sharp peaks and valleys into an even line. The rectifier is a simple diode. The smoothing thing is known as an 'integrator', and is nothing more than a resistor and a capacitor which form a rudimentary low-pass filter. Several capacitors are usually provided, selectable by a switch, to allow different amounts of smoothing or 'time constant'.

A simple rectifier/integrator arrangement is shown in Fig.4. The transformer is a small 240 volt to six or 12 volt unit, hooked up in reverse. The low voltage side plugs into the external speaker or headphone socket of your receiver. The high voltage side goes to the rectifier. The transformer's purpose is to provide a reasonable 'speaker' impedance back to the radio, while stepping up the voltage so it's easy to handle in the rectifier/integrator.

The values of the resistor and capacitors should be determined experimentally. Suitable capacitors might range from 10 to 100uF. As for the resistor, maybe 1k or 10k. Capacitor and/or resistor values too high will produce too much smoothing, losing detail from fast-moving waveforms. Values too small will contaminate your observations with signal variations such as audio feed-through, which are not part of what your are trying to observe.

Observing the Sun

Lots of interesting signals come out of the Sun. Basically there is a constant level of noise, punctuated by much stronger bursts which accompany solar flares. There are other emissions as well, although we don't have the space to detail them in this article on basic reception techniques.

Solar frequencies are generally in the 100 - 200MHz range, hence the use of an FM broadcast receiver or a VHF scanner. An interesting experiment is to point an antenna at some area of the sky where the Sun will cross, and then watch the noise level increase as the Sun approaches and decrease as it passes away. At these frequencies most activity will be as a result of solar flares, so times of intense solar disturbance are the best times to look for signals.

It has occurred to me that users of the Listening Post Wesat weather satellite receiving system might already have an interesting 'solar' radio telescope. If you have built the Lindenblad receiving antenna from *EA* August 1992, and the VK5 VHF

Jupiter Squawks!

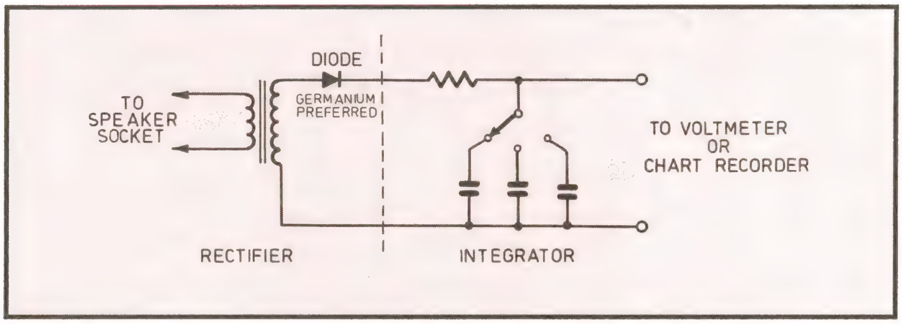


Fig.4: A simple rectifier and integrator system which can be used to drive a voltmeter or chart recorder from the external speaker socket of a standard communications receiver. A small mains transformer is used 'backwards'.

preamplifier, you possess a very sensitive receiving system in the general area of solar emission frequencies.

Since the Lindenblad is a non-directional antenna, it should be able to receive signals from the Sun any time the Sun is above the horizon. If you tune slightly away from the weather satellite frequencies, perhaps you'll hear some solar flares wreaking their havoc on the ionosphere. I don't know if this will work; I haven't tried it yet. But that's what radio astronomy is all about — suck it and see!

Observing Jupiter

Ah, here's where the fun starts. One of Jupiter's four moons, called Io, produces an effect that has caused much curiosity and confusion among astronomers. Io travels in a rather asymmetrical orbit, moving toward and away from Jupiter. It's believed that Jupiter has Van Allen radiation belts, just like Earth. And when Io drops low enough to sweep through Jupiter's Van Allen belts, it causes some kind of mechanism to take place that results in the release of enormous amounts of radio energy. What we're talking about here is *millions* of watts of power.

Now Jupiter is something like 600 million kilometres from Earth, so the radio 'path loss' is pretty severe. But then again, there's a lot of power being transmitted. The upshot is that the signal arriving at Earth is strong enough to be detected by pretty simple equipment: a shortwave receiver and a dipole.

The signals aren't real big — they won't move the receiver's S-meter, but they are generally clearly audible. So you can listen to them, tape record them, or graph them on a chart recorder.

The Jupiter signals have a very distinctive sound. Many people describe it as a swishing noise, or a sound like breaking surf, repeated at regular intervals. To me it sounds like — well, if you hold an imaginary candle in front of your mouth, and then blow it out, the 'whoof' you make is what Jupiter sounds like. That's assuming it's Jupiter I've heard, of course. One can never be 100% sure of these things.

Jupiter isn't the most reliable performer, and sometimes many days will pass without it making a peep. Io has to be in just the right place, and then the energy is believed to be emitted as a directional beam. So that beam has to be sweeping across Earth as well. Then we can hear Jupiter.

The emission is on a fairly broad band of frequencies, generally between 20 and 24MHz or so. To listen for the signals, you must first find a frequency within that range that is totally free of any interference from Earth-based transmitters. These signals almost always arrive via the ionosphere, so night is the preferred time to listen since the ionosphere is less active and fewer stations are coming in on 'skip'. Having the Sun out of the way also eliminates another potential source of noise.

Of course Jupiter must be above the horizon as well, so you must work out times when Jupiter is 'up' and the Sun is 'down'. These times vary somewhat, but as this is being written there are a good 10 hours every night when the conditions are met.

Another factor is man-made noise, from things like fluorescent lights and TV sets. So success is more likely when everybody else is in bed — you probably won't even bother looking until after midnight. Sorry, you're not going to get much sleep, but that's what astronomy is all about!

An interesting exercise in self-torture is to set the alarm clock for say 2am, roll out of bed, and turn on the receiver. If you hear nothing for a few minutes, go back to bed. If this procedure is repeated over several nights you should hear Jupiter with a bit of luck. (You're also likely to hear from disturbed family members...)

Probably the best idea at that time of the night is to tape record your signals for later analysis. Then you can front up for breakfast the next morning saying "Guess what! I finally recorded some signals from Jupiter last night!" And if your family is like mine, they'll say "So what?".

Well, it isn't easy being a great radio astronomer. I'll bet Jansky and Reber got the same response.

Finding your targets

We said before that Jupiter has to be above the horizon before we can receive its radio emissions. But how do we know when Jupiter is 'up'? The traditional way is with a book called a 'sky atlas', which lets you work out the location of any celestial object at any time. But nowadays that's doing it the hard way.

Computers make it easy, and there are several programs around that produce a map of the sky, shown at any particular time over several thousand years in some cases. I have tried several of them, but one stands out above all the rest. It's a shareware program called *Skyglobe*.

Fig.5 is a printout of *Skyglobe*'s screen display, with some artwork enhancements from me to make the moon and Jupiter stand out. This particular view is looking straight up from Hobart, Tasmania. The big circle then represents the horizon in all directions, and various stars, constellations, and other objects are clearly seen.

You can tilt the display down toward any direction, zoom in on a particular area of sky, and you can select the view from just about any point on Earth. The program contains a large library of world cities. You can also tell the program to find and lock onto any particular sky object, and there is a library of these as well.

I could rave on about *Skyglobe*'s features all day, but we've got other things to cover. All I can say is that it's one of today's few examples of elegant programming. I took it along to a computer group meeting one night and everyone, mostly non-astronomers, pronounced it the greatest thing they'd seen in ages. I had it running on my Toshiba notebook computer, and the whole club eventually ended up in the car park, spotting stars on *Skyglobe*'s screen and then picking them out in the real sky.

With the help of *Skyglobe*, finding Jupiter is dead easy. The planet is very prominent and bright, and it appears as a true disc instead of a point of light when viewed through an ordinary pair of binoculars. You can use *Skyglobe*'s screen display to find Jupiter's times for coming up, going overhead, and then setting again. *Skyglobe* should be available on most computer bulletin boards, but if you can't find it I can fix you up with a disk for the usual service fee of $10.00 posted to Australia or New Zealand. Write to High-Tech Tasmania, 39 Pillinger Drive, Fern Tree, Tasmania 7054, Australia. Money order or cheque please, and in Australian dollars only.

The big prang

This is what we've been working up to in this article — preparing to observe the impact of Comet Shoemaker-Levy into Jupiter, occurring on or about the 21st of this month. This could be particularly interesting from a radio astronomy point of view, because of the violent activity that already takes place under the influence of the tiny moon Io. What's going to happen when a giant comet sizzles through Jupiter's Van Allen radiation belts?

There could be a truly enormous release of radio energy, dwarfing the effects that Io causes. Then again there could be nothing... a fizzle instead of a sizzle. What will happen if Io and Jupiter are already reacting, and the comet barges in as well?

We intend to find out, and hopefully many readers will be observing as well. I have arranged to spend the period of the impact camped at Grote Reber's original radio astronomy site at Dennistoun, near Bothwell in Tasmania. We will install and operate a Jupiter-style radio telescope under the direction of Grote Reber himself. He was among the first to observe signals from Jupiter:

"Yes, I observed it, but I didn't know it at the time. In fact Jupiter was observed by several people, including myself, before we wised up. They didn't know what they were measuring, but they went out and looked. And lo and behold, in the direction that their radiations were coming from, was Jupiter. And they just found it by chance."

"And after that was determined, then other people looked through their past records and people down here in Australia found it. I was in Hawaii at the time, and I looked in my Hawaiian records and it was in there. So, it was just one of these things; there wasn't any obvious thing out in the sky, and only when it became apparent this was connected with Jupiter, people looked."

City people might find electrical noise a bit testing while trying to observe the Jupiter event, but in Tasmania we should have things a little easier. I'd always thought a little town like Bothwell would be pretty radio-quiet, but it's nothing compared to the Dennistoun site a few kilometers north. This is considered the quietest radio site in the Southern Hemisphere, and it's what attracted Grote Reber to live in Bothwell in the first place:

"Actually there's electrical noise around Bothwell and I get it on the broadcast band, and sometimes it's there and sometimes it isn't. It's a sparkling noise that's characteristic of the mains, you know. If it's not too loud, OK, but we may want to set up out there (Dennistoun), because it IS quiet out there."

We intend to use an Icom R-71 as the shortwave receiver, running from a car battery. The planned antenna is shown in Fig.6. It is a simple folded dipole made of 300-ohm television feed line and cut to resonate on 22MHz. The feed from the antenna to the radio will also be 300 twinlead, going through a 300 to 75 ohm balun just before it enters the radio.

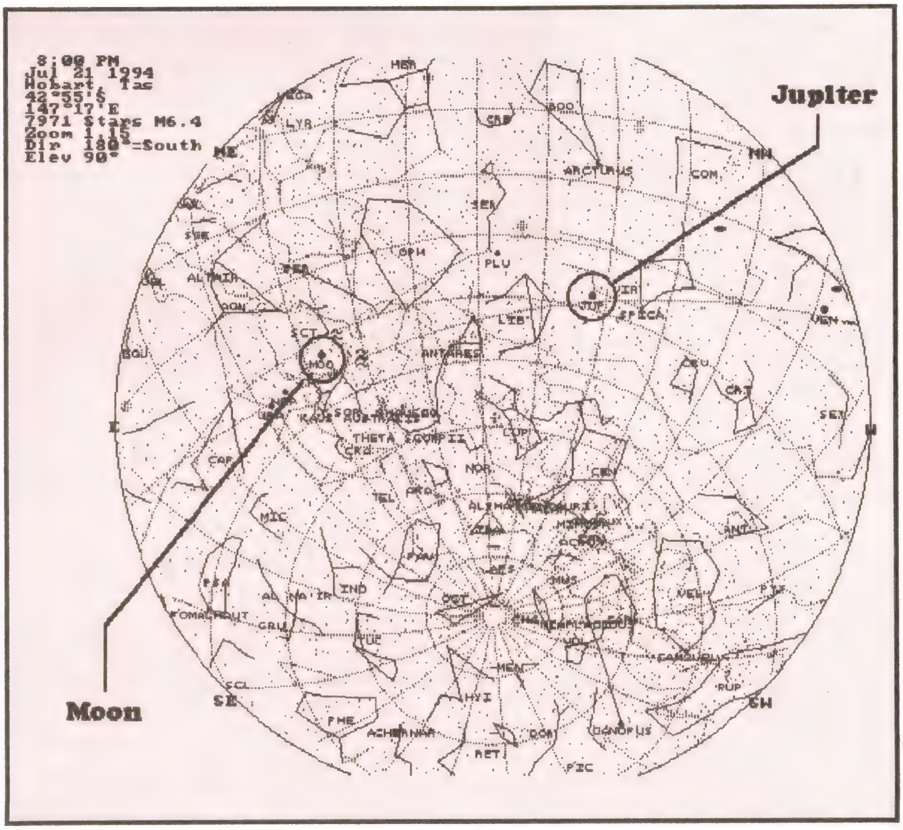
At this stage we intend to poke some holes at regular intervals along the dipole's insulation and thread some nylon rope through them. The rope will thus support the dipole, but not put any stress on it. The rope can then be tied between two trees, or between one tree and a portable mast we will have with us.

Other radio astronomy publications have sometimes described a 22MHz antenna built as a loop suspended above a reflector. Because of size limitations the loop antenna can only be something like 1/8 of a wavelength in circumference. This would present a very weird impedance to the receiver, and there would be serious doubts about the antenna's efficiency.

I put the loop idea to Grote Reber, but he was adamant: "Forget that. You've got to have lots of wire up there. Go for the dipole." So we won't bother with any funny loop designs. A dipole it is...

I have been agonising over whether to use a special 22MHz preamplifier with this setup. On one hand it will maximise the sensitivity of the whole system. But on the other hand, any extra gain on top of an already excellent receiver sensitivity would compromise the radio's dynamic range. It would be a shame to have the receiver's front end overload for some reason, just as the fun starts on Jupiter. And a preamp is just one more thing to go wrong. We'll have to see what Grote Reber thinks about it.

As well as the radio gear, we have an optical astronomer coming along on this expedition with a five-inch reflector telescope so we can observe Jupiter visually as well as by radio. We may be in a position to record it on video or take photos — this problem is still being sorted out.



```
 8:00 PM
Jul 21 1994
Hobart, Tas
42°55'S
147°17'E
7971 Stars M6.4
Zoom 1.15
Dir 180°=South
Elev 90°
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Fig.5: A typical printout from 'Skyglobe', a shareware program which allows you to find the position of a celestial body like Jupiter, using your PC.

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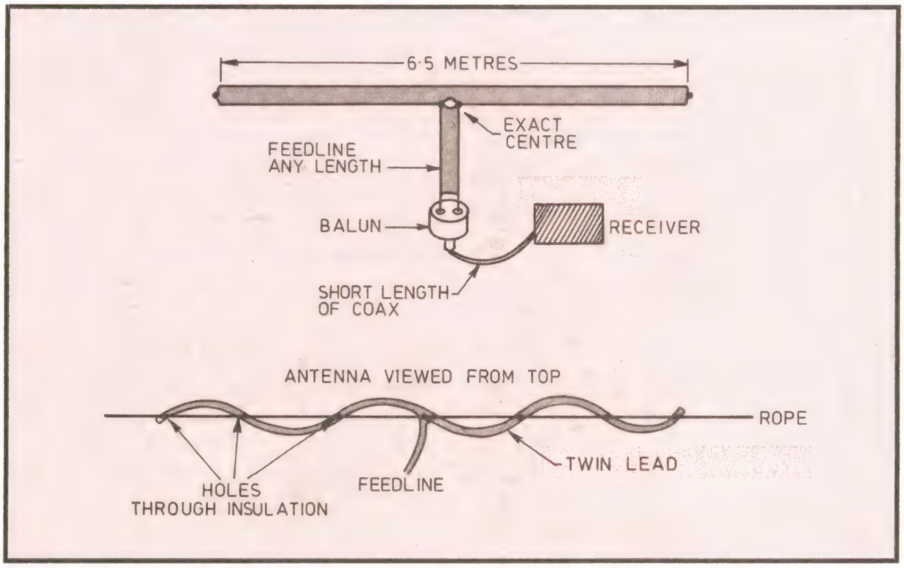

Fig.6: Details of a simple low cost folded dipole antenna for 22MHz reception. This is the kind of antenna required for listening to Jupiter...

Of course the whole optical effort is wasted if the sky clouds over. But if the night is cloud-free, seeing Jupiter should be easy. The *Skyglobe* display in Fig.5 shows the sky on July 21 at 8:00pm, the predicted time of the big impact. The moon is up, and full, but far enough away from Jupiter so it should not affect the visibility too much. Otherwise the sky should be absolutely clear and cold...

In fact Bothwell regularly reports the lowest temperatures in Tasmania, and we will be there in the dead of winter. The things one goes through in the interests of science!

Knockers will say that it's useless trying to enter into radio astronomy on an individual basis, or any other scientific field for that matter. They'll say it's all been done before; you'll just be repeating someone else's experiments, hoping to get the same results. But this Jupiter event goes to show that it all HASN'T happened before.

In fact most new comets are discovered by amateur astronomers; they have the time and dedication to simply look upward, with an open mind. Who knows what they will see?

Grote Reber puts it very simply: You can't just make theoretical predictions and then go out and 'discover' them. It's more a matter of curiosity, coupled with good luck.

"If we knew what they were, we would discover them. But we don't know what they are. Current dogma says that somebody gets a bright idea called a 'theory'. And then equipment is set up to discover this thing, whatever it is. And if the results are positive we have a discovery."

"But that isn't the way it works. It works more like Jansky's thing; that is, somebody's doing some observations and they notice a deviation that isn't part of the work. But this deviation whets their curiosity. And so they start looking at this deviation. And if they persist and have the time, then there's a discovery. But nobody's told them that; nobody's had the slightest idea about these things. And I think that's the way discoveries are going to continue to be made."

All right, future radio astronomers. Grab your receivers and dipole antennas and go for it! Hopefully to some radio-quiet site, on the night of July 21. Even from the centre of Sydney or Melbourne it's not that far to drive out to a quiet camping spot in the country. And most modern receivers will run from a car battery.

The July 21 date may be a little slippery. As the Shoemaker-Levy comet progresses toward Jupiter, it is breaking up into fragments and apparently varying in speed. I suppose it's like being able to throw a rock harder than a handful of sand. But either one will make a big mess when it hits something at speed...

Astronomy magazines have said they will provide monthly updates. But as this is being written, I have been unable to find any recent astronomy magazines in any newsagents. Perhaps as the date approaches and the end of the world appears possible, the mainstream media will become interested, as they did with Halley's Comet a few years ago. So keep your eyes and ears open, and perhaps when it's all over we can all compare notes. ❖

Telecom's pay-TV network

Continued from page 9

Windows-like interface

In order to make the user interface more friendly, Zenith, like other set-top manufacturers, has developed a *Windows*-like menu on the customer's TV screen. Although there are four levels of menu that can be scrolled through, the main screen would give the evening's viewing guide for the complete pay-TV network. By using the arrows on the infra-red controller, the viewer can quickly work his way through the program listings, stopping at any program to get more details or to view the show.

If this menu information were sent from the head end to the set-top unit every time a viewer used the menu, a lot of data would be continuously transmitted over the network — causing serious congestion. To overcome this, Zenith's set top units can contain either 1Mb or 4Mb of memory. Periodically, say once each hour, the head end broadcasts to each set-top unit a complete update of the evening's viewing guide. Other uses for the menu system is to provide advance notice of programs or special events, as well as providing a general bulletin board.

Another advantage of using addressable set-top units is to is to be able to send customised messages to groups of subscribers or individual subscribers. Messages can be sent saying 'Happy Birthday Mary, Love Dave' (for a fee of course) or 'Your bill is 7 days overdue, you will be disconnected on XXX'. The range of personalised messages seems endless.

There are, of course, problems with set-top units. Each set-top unit contains a single remodulator to convert the incoming TV signal to channel 0 or 1. Also, each set-top unit contains the circuitry to descramble one TV channel at a time. If there are two TVs in the house, only one TV will be able to show a scrambled program — unless both TV's show the same program. The other TV will only be able to show an off-air unscrambled program that can be selected by the TV's own tuner — unless, of course, the customer decides to rent a second set-top unit.

This article has laid the foundation for understanding the pay-TV network and the use of set-top units. In the second article we shall look at the ways TV signals can be scrambled in a pay-TV system.

(To be continued.) ❖

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Sydney's last 'Step by Step' Telephone Exchange:

THE END OF AN ERA

An era of telecommunications history closed early on Sunday April 10th in Sydney, when the last step by step (SxS) automatic telephone exchange equipment in Sydney was cutover to Alcatel System 12 digital equipment at Guildford, in Sydney's South West. However because this technology played such a key role in the development of communications, moves are afoot to ensure its preservation...

Often remembered as the 'Strowger' system, the basic ingredient of an SxS exchange is the *bi-motional selector*, an electromechanical relay device consisting of copper wipers which move over a bank of contacts to select the desired line. In an exchange, the SxS switches were connected together in stages, each switch controlled directly by the current pulses supplied from the subscriber's dial.

With each dialled digit, a switch would be siezed and vertically stepped to the desired number level, after which the switch would 'hunt' around the bank of contacts to find a free outlet and thus connect to the next switch in line. The final selector received the last two digits, tested the called line, and connected directly to the required line by way of the final selector bank, providing ring tones and current accordingly. The system gained its name from the way each call would make its way through the exchange 'step by step'.

The SxS switch was invented early this century out of the frustration of a Kansas undertaker named Strowger, who felt certain that the manual operators were deliberately depriving his business of calls. As a result, he determined to eliminate manual exchanges. He is said to have sat down with a cardboard collar box, some matches, a row of pins, and worked out the theory of an automatic switching system.

A few years later he was able to perfect the device, which became the standard exchange switching device worldwide for decades to come.

The first public access example of this automatic design in Australia was in Geelong, Victoria in July 1912. The *Geelong Advertiser* described its 800 line local exchange as follows:

> *Nothing could be nearer human — to see it work and grasp what it does, makes it seem supernatural. It is so ingenious as to almost beggar complete description.*

The first Australian examples were supplied from AEC in Chicago, from 1912 to 1915. By 1919 a design had been evolved which was to set the pace for all automatic exchange technology in Australia until 1960. Shortly before the second world war in 1939, Australia embraced as a standard design, the BPO (British Post Office) '2000' type switch, which included many features learned from the 20 years of the technology in service. As a result, the 2000 type switch was a very reliable machine indeed, and became standard in most 'Commonwealth' countries.

Shortly after the war, concern grew about Australia's vulnerability to the beck and whim of overseas markets, so the 'SE50' switch was developed and totally manufactured in Australia. Based on the 2000 type, it was fully interchangeable with the earlier switches, and had extra features to further refine the technology (like a different switch release function).

It is this type which was still in service at Guildford until April 10th this year. Most SxS equipment lasted around 40 years. There are still some small pockets of SxS plant, totalling 35,000 lines, left in service in regional Australia — all to be replaced very soon.

Guildford's equipment

The exchange at Guildford typifies the classic changes which occurred to SxS exchanges in Sydney over the years. Installed in 1957, it grew to serve the number range between 632-6000 and 632-0000. By the mid 1960's, Crossbar 'ARF' exchange technology began to cater for further growth.

In the early days, Guildford was actually a satellite exchange working from Granville Sub Main, which in turn worked from Homebush Main Exchange. This meant that on lifting the receiver, subscribers connected to Guildford were actually served dial tone from first selectors in Homebush, via special 'DSR' (Discriminating Selector Repeater) switches at Granville. This was known as a 'Trombone Trunking' arrangement — so called because even local calls within Guildford would proceed via junction lines to the DSR's at Granville, and back again to 5th selectors at Guildford.

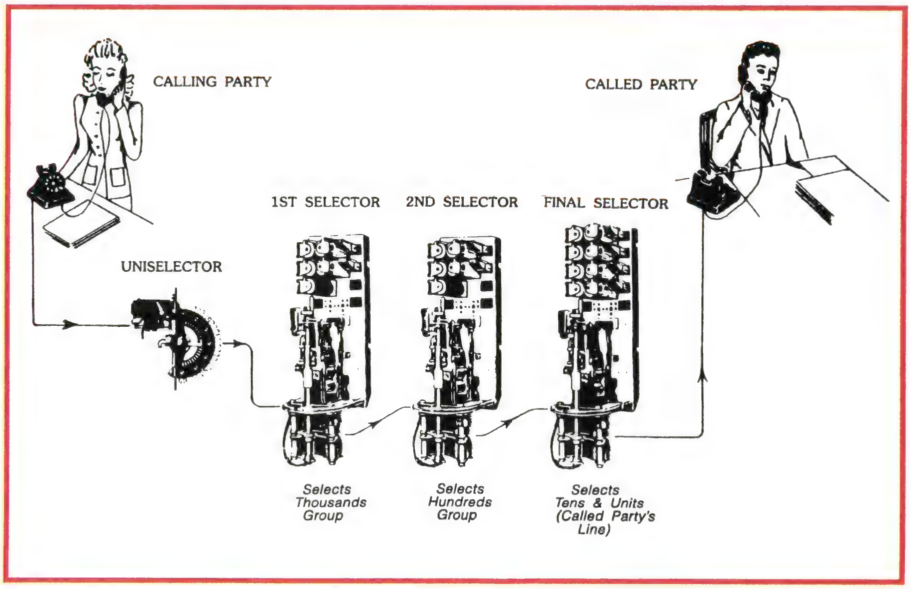

Fig.1: The principle behind a 'step by step' telephone exchange.

Fig.2: Guildford exchange staff Eugene Kleibert, Gean Vella and Victor Beilokin standing alongside the recently retired equipment.

Granville was equipped with junctions to most exchanges around Parramatta, for which calls proceeded through the DSR's. Calls to the inner city were switched at Homebush Main, with the DSR's operating as a repeater only.

With the introduction of the adjacent Crossbar equipment in 1965, the SxS was modified using a scheme known as 'SR/B' switching. This meant that instead of trombone trunking calls to Granville, all outgoing calls were connected directly with the newly installed adjacent crossbar equipment at Guildford. This arrangement provided efficient use of junctions by removing the trombone trunking problem. Local subscribers now received dial tone from their own exchange directly, instead of from distant Homebush. Incoming calls to the SxS part of Guildford remained unchanged.

The next change was to occur in 1986, when the adjacent Crossbar equipment at Guildford was converted to microprocessor control and re-designated as 'ARE' type equipment. At the same time a special device known as an 'AB-ID' (A-B-I-Dentification) was added to the SxS equipment, to permit the microprocessors to be able to identify each individual calling line (CLI — or Calling Line Identification). This change gave the SxS subscribers new facilities equal to the latest equipment, like tone dialling capability and itemised STD and ISD calls on their bill. All of these extra facilities used essentially the original SxS designed equipment from 1957.

Over the years since 1986, the introduction of digital exchange equipment (AXE) has progressively reduced the number of analog junctions which connected to the SxS equipment. Indeed nowadays although many local exchange machines are still Crossbar, the paths between the exchanges are all digital, using both metallic and optical fibre junctions. Digital PCM interface units were developed to permit the interworking necessary with the older equipment at a local level.

Cutover to digital

A cutover of exchange equipment is a complex task, and development of Guildford had commenced a number of months before April. Installation of the new Alcatel 'System 12' digital local switch equipment was done hand in hand with the daunting task of analysing the relevant data of every connected customer and ensuring the new data was correct.

Also, the rest of the network's 'intelligence' had to be 'told' where it could find the customers' lines after the cutover. This involves changes to exchange data in dozens of surrounding exchanges and nodes. Fortunately, sufficient digital equipment exists in the

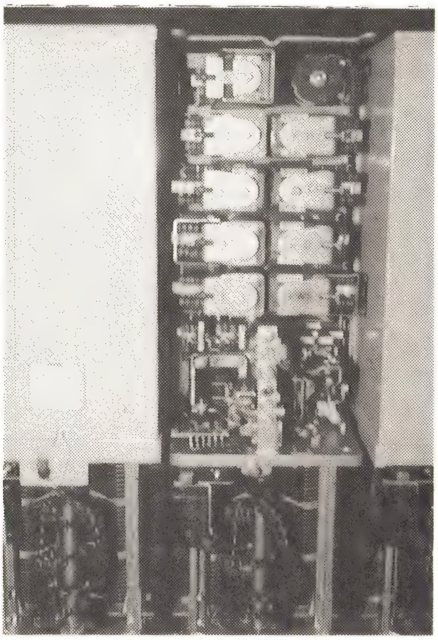

Fig.3: View of an SE50 type selector switch with cover removed.

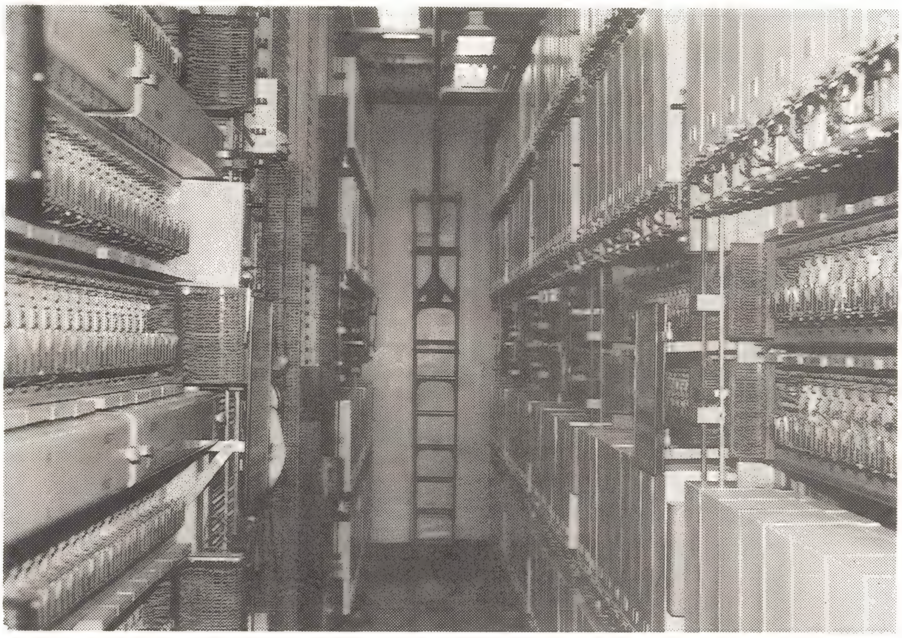

Fig.4: Granville's DSR (Discriminating Selector Repeater) switch racks, a typical SxS facility. Each side is called a 'suite' with 10 switches per rack.

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NOTES AND ERRATA

Light and Sound Trigger (April 1994): The overlay diagrams for this project were printed in reverse. These overlays will be reprinted the right way round in the August edition for interested readers.

Computer News and New Products (March 1994): On page 127 the phone number listed for Jands Electronics was 416 3622. This number should be 516 3622.

ACS Decoder (September, October, December 1993): To prevent radiation of high frequency components from the DC supply leads (which can degrade the signal to noise ratio of the receiver), add a 0.1uF ceramic or monolithic capacitor directly between the 'V+' and 'GND' pins on the decoder board itself. ❖

The end of an era

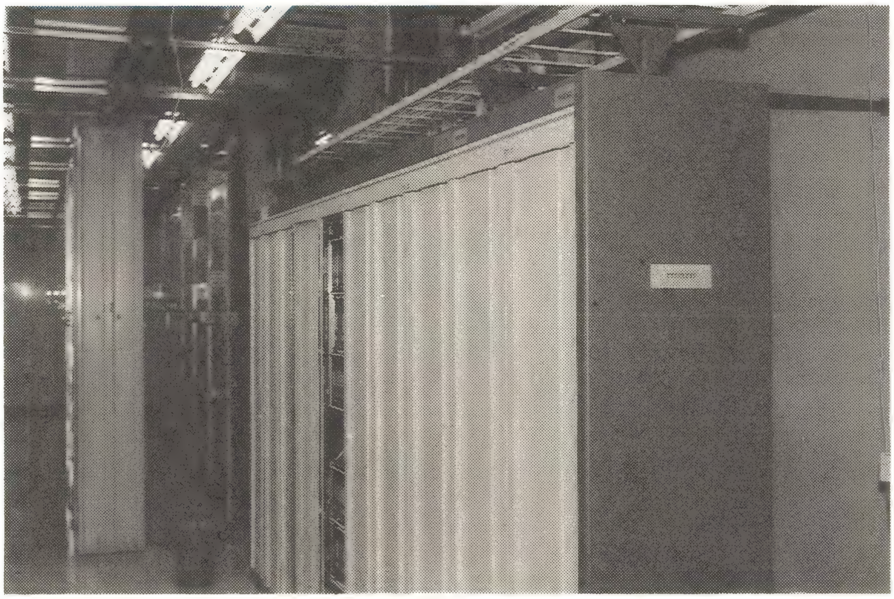

Fig.5: This single suite of Alcatel System 12 equipment replaces the older SxS suites downstairs, which take up 10 times the floor space.

network now for it to be feasible to carry out such a cutover almost like a staged event.

On Friday afternoon, April 8, the remaining analog junctions between the SxS equipment and the adjacent Crossbar were 'busied out'. This left all traffic from the SxS traversing the digital network, even if local. Earlier, the Parramatta AXE node (the principal controlling digital node in the area) had been programmed to change the trunking data for the associated customers from the old equipment to the S12 switch in the small morning hours of Sunday 10th, without human intervention.

The S12 local subscriber terminal blocks had been 'double jumpered' to the line side of the Exchange MDF (Main Distribution Frame) months beforehand, and all that was left was the cutover itself.

The cutover was performed early on Sunday morning to minimise any possible disruptions to traffic. At the programmed time, the customer's lines were disconnected from the SxS by removing special links on the MDF equipment side. Less than 60 seconds later, blocking picks were removed from the new equipment terminals serving the S12 equipment, with the help of long strings passed through several thousand at a time.

Call testing then commenced, with success pronounced not long after. The cutover was staged without a single equipment alarm being recorded.

The SxS at Guildford now sits silent, whilst just a few suites up the aisle the Crossbar is still clicking away happily. The double jumpers are left for a while, 'just in case', but the cables between the SxS and the exchange MDF will eventually be removed along with the old equipment.

Removal of the old SxS equipment is very tricky, as many special supervising alarms and tone generators exist — often connected to adjacent crossbar equipment which is still in use. The weight of the equipment is such to cause buckling of suspended concrete floors if it is not removed in a specially engineered sequence.

Guildford now joins several other exchanges in Sydney where SxS is still in place, connected but not operating. Vale SxS!

An opportunity

Such a technology, which served Sydney (and indeed Australia) for 75 years, and touched the life of all of us, surely cannot be allowed to fade into history without some sort of recognition. After all, Sydney was once served by one million SxS lines.

As it happens, *you* can do something about it. With the help of interested enthusiasts, a working example of this technology can be preserved for the benefit and education of us all.

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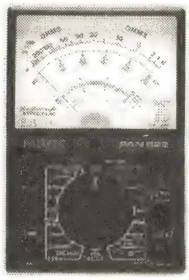

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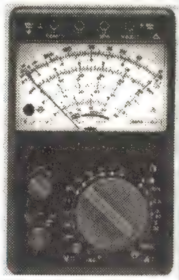

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- 0.4% dc accuracy
- Touch-Hold
- 3200 count digital display
- 31 segment bargraph
- Manual/Auto Ranging
- 10A current

$222*

Appa 96

- 3 1/2 digit
- 0.5% accuracy
- 41 segment bargraph
- 20A current
- Memory offset
- Water resisitant
- Data Hold
- Holster

$175*

Fluke 87

- 4 1/2 digit mode
- 1ms peak min/max recording
- 0.1% accuracy
- True rms
- Analog pointer
- Backlight
- 20kHz bandwidth
- Holster

$695*

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- Automotive
- Large display
- Dwell
- Tacho
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- Water resistant
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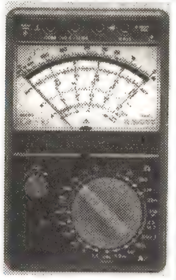
Pantec 50XT

- High sensitivity 50kΩ/V
- 36 ranges
- 2.5% accuracy
- Continuity buzzer
- Capacitance
- Carry case

$156*



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- 3 current ranges

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- Sleep mode

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Appa 98

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- 0.5% accuracy
- Frequency
- Capacitance
- 41 segment bargraph
- Memory offset
- Holster

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Pantec 2045

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- 0.5% accuracy
- Auto/Manual ranging
- 200μA/10A current
- Temperature with K type thermocouple
- Logic

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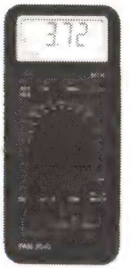

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- 12.5Aac/2.5Adc
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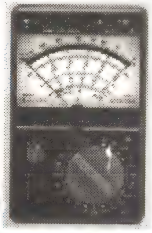
$129*



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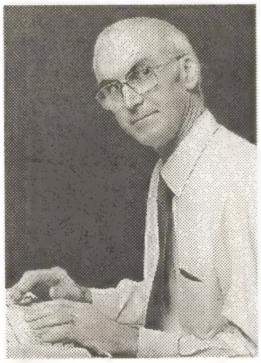
FORUM

Conducted by Jim Rowe



In defence of amateur radio and 'backyard' service people...

Not surprisingly, there's been a response to that letter I published in the May column from an 'old fogie', who went even further than Tom Moffat and suggested that amateur radio had no real future as a communications activity. There's also a letter in response to the reluctant decision by Jim Lawler, of TETIA's Tasmanian Branch, not to support the publication in our Serviceman column of interesting equipment faults and their cures — plus a couple of other items I think you'll find of interest as well.

You may recall that Tom Moffat gave a bit of a serve to some of the less attractive activities of radio amateurs, in his November 'Madhouse' column. This produced quite a response (mainly in support of Tom), which I published in the Forum columns of both February and May. But one of the letters in May went rather further than Tom had done, and made some very critical comments not just about the behaviour of some amateurs, but about the amateur radio movement in general. The letter was written by a long-time amateur and WIA member, you might remember, who supplied his full identification but asked to be known by the *nom de plume* of 'an old fogie and WIA member who doesn't have his head in the sand'.

The letter was fairly obviously meant to 'stir the pot', and I decided to publish it in the hope that it would do just that. Although we'd had quite a good reaction to Tom's criticisms from shortwave listeners and other non-hams, we really hadn't had much from radio amateurs themselves, and I thought the somewhat over-the-top criticisms from 'the old fogie' might just succeed in this area where Tom's had failed.

Well, I was at least partly right. A letter defending amateur radio has certainly arrived, and from a well-known and highly respected amateur at that: Drew Diamond VK3XU, who is a frequent contributor to the WIA's *Amateur Radio* magazine. Regular readers of that magazine will know that Mr Diamond is a keen experimenter and build-it-yourself enthusiast, and *AR* has published many of his interesting designs for amateur radio equipment.

Anyway, here's what Mr Diamond has to say, in response to our 'old fogie':

Here we go again (Forum for May), with regard to Mr Nom de Plume and his letter. As we don't know who the person is, let me, through your column, put him straight on two or three points:

Home building has not 'died out' (what's his definition of 'died out'? 6dB down on 1953? 10dB maybe?). There has not been a better time for homebrewing of radio/electronics equipment in years. There are some lovely devices available now which make home construction a delight. Contrary to some opinion, you CAN get the parts; all it takes is a little enthusiasm. And there's plenty of that too.

He mentions Amateur Radio Magazine (the WIA journal — describes it as a 'useful' publication), where each and every month, details are provided for construction of all types of amateur radio equipment (when was the last time EA did a decent HF receiver, or an SSB transceiver, eh?). If no-one is building, why is there such a high technical content in AR?

Morse Code has not 'died out'. Listen on the HF bands any time and see for yourself. I happen to like Morse (in fact I love it), but I would never ram it down some-one else's throat. Many amateurs in the poorer countries simply cannot afford the technical whiz-bang items mentioned. The construction of a simple Morse transmitter and receiver may be about as much as a poor fellow can manage. And the magic of it! By simply putting a few components together, he can be in touch with other enthusiasts all over the world. No fancy Telereader, no satellites. And the language problem is considerably reduced by using Morse, which he encodes/decodes IN HIS HEAD using a precious, hard won and worthwhile skill. How many of our 'Macdonald's Culture' would be prepared to invest the hours necessary to acquire such skill?

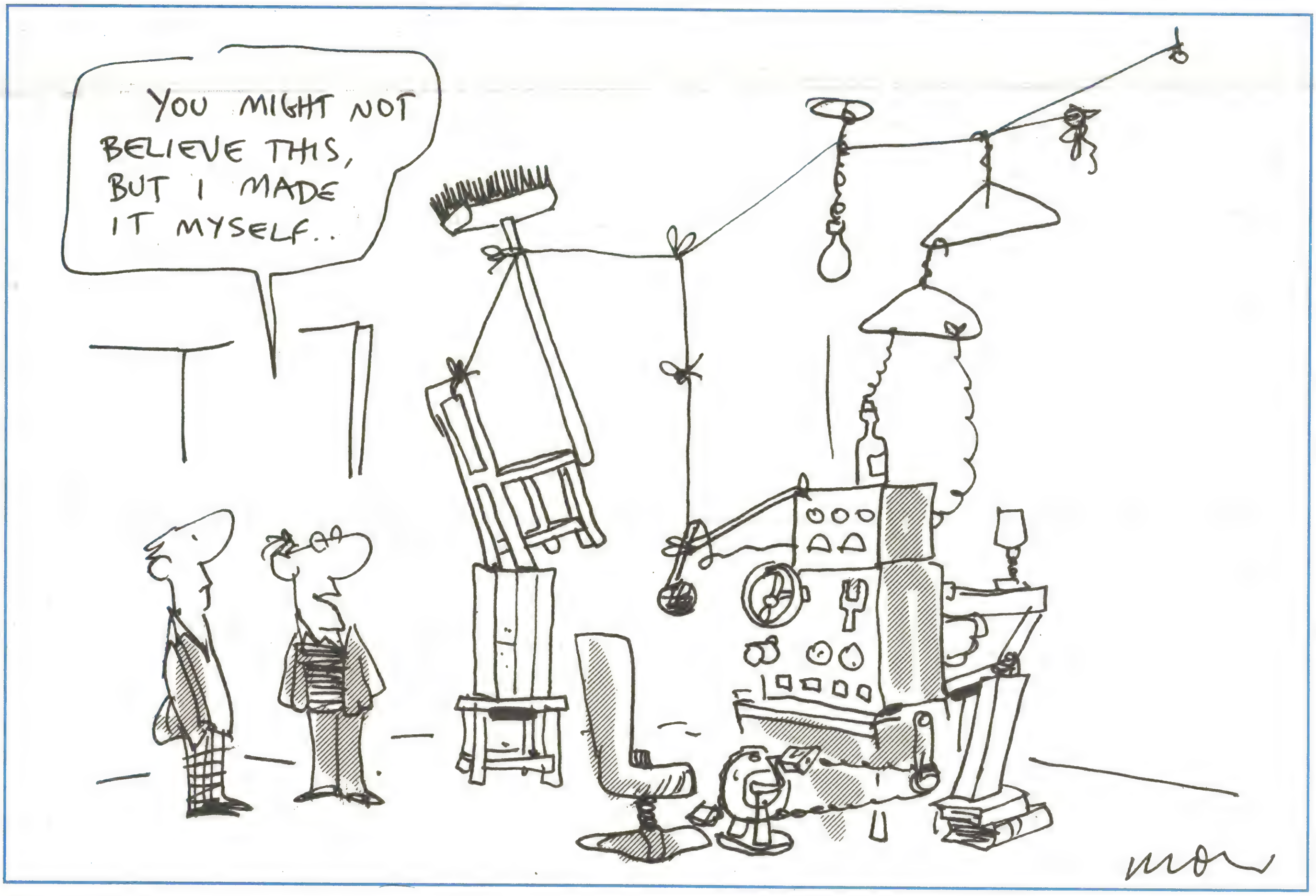
Conversation has died out? When I'm in the workshop — soldering away on an electronics/radio project, I like to leave the receiver running on one of the Amateur bands and listen in to QSO's. It's much better than the BC radio, and some of the contacts heard have been very interesting.

I hear fellows helping others in debugging software programs, offering construction tips, discussing holidays and so on. Many of them are a delight to eavesdrop upon. Rarely (yes rarely) do I hear rudeness of any kind. It is probably fair to say that amateurs may be approximately representative of the adult population as a whole — where indeed occasional unpleasantnesses (especially in road traffic encounters) may occur.

From this distance it is impossible to understand what is going on in the NSW Division of the WIA. There appears to be some struggle of egos on a mammoth scale. (From listening to stories my father-in-law tells me, similar things go on in the Bowls Club and — heaven forbid — the RSL!) Nevertheless, such behaviour is inexcusable.

Thank you for your response and comments, Mr Diamond, and I'm sure the positive point of view you express will help balance the picture, in terms of the public perception of amateur radio.

You may well also be right in your claim that there's never been a better time for home brewing of radio and electronics equipment. There are certainly some very impressive devices and components available, as you say, although some of them are not easy for many peo-


YOU MIGHT NOT BELIEVE THIS, BUT I MADE IT MYSELF..
mor

ple to acquire in small quantities. At times they may not be readily available for all that long, either, as I feel sure you've discovered yourself. No sooner do we design a project around some of them, than they are suddenly declared 'obsolete' by the manufacturer (or importer) and discontinued!

Of course, even if this *is* a particularly good time for home construction, that's not in itself a guarantee that lots of people are actually building things. There's rather more to it than that, isn't there? Having all kinds of 'lovely' bits available is really only the start...

In fact my impression is that there *has* been a reduction in the level of home construction — particularly in amateur radio — over the last 15 years or so, and your own comments about '6dB or 10dB down?' suggest that you are probably aware of this too. Perhaps it's due to the general reduction in all kinds of traditional 'hobby' activity, and/or to people thinking that electronics has become 'too technical' for them to understand.

Yes, I take your point about *AR* publishing a regular stream of radio construction projects, while *EA* has not described a 'decent' HF receiver or an SSB transceiver for some time. But we *have* described a modest number of amateur radio projects, including an updated two-metre FM transceiver, an 80m DSB transceiver, a VHF testing system and so on. We'd no doubt be able to publish *more* amateur radio projects, if we got a bit more support and help from radio amateurs themselves — including (I have to say it) the really active people like yourself, Mr Diamond.

I believe that amateurs like yourself prefer to support the official WIA journal, because it's a non-profit publication and the WIA is the only organisation which aims to fully represent the rights of amateurs. Fair enough, too — but surely then it's a bit unfair to criticise *EA*, for not having many amateur radio projects! After all, like many technical publications nowadays we have to operate with a much smaller staff than in the past, and as a result there's a definite limit to how many projects we can develop by ourselves, 'in house'. We too have to rely a lot on contributed material, so if there isn't many amateur radio projects in *EA*, that's really a reflection on radio amateurs themselves, just as much as the magazine.

I note your comments about Morse, and the way its 'low tech' nature allows people in poorer countries to take part in amateur radio. That's great; it just seems a pity that Morse also often seems to be a factor in splitting amateur radio into opposing camps — the Morse-literate group and the rest. And although I imagine it can be very satisfying and rewarding to use Morse once you've mastered it, you suggest yourself that many people in today's 'instant' culture may not be prepared to invest the time in gaining this mastery. Have you also considered that many of us simply don't *have* the time to invest, either?

Finally, I note that in your comments about the interesting conversations you hear on the bands, you make no mention of contests. Have you never heard the unruly chaos that many contests seem to degenerate into, and that has been commented on by other people?

It's strange that many amateurs seem to be quite unaware of most of the less attractive behaviour that occurs on the bands, and like yourself claim to have rarely ever heard any swearing or other unpleasantness. Other people seem to be able to hear these things, so perhaps there's some aspect of amateur radio activity which causes a subtle deterioration in hearing...

You're quite right, of course, that radio amateurs are no doubt representative of the population as a whole, and that antisocial and unpleasant behaviour is widespread in many activities and organisations — along with struggles for personal power. But if amateur radio *does* want to lift its game above the average, I suspect this can only be done by confronting the problems squarely rather than pretending they don't exist.

I'm not suggesting that Drew Diamond himself is doing this. But it does seem that many amateurs adopt a 'wise monkeys' approach to the problems facing their hobby: pretending that the problems don't exist, in the hope that they'll go away. It doesn't seem to have worked up until now, and I doubt whether it will in the future.

Other people, especially those involved in management of the spectrum, are not necessarily able or willing to share in this collective deafness.

'Qualified' — how?

Now let's change the subject, to one that's probably almost as thorny. You may have noticed in the April Serviceman column (page 46) an announcement by Jim Lawler, the secretary of TETIA's Tasmanian branch, to the effect that he would no longer be able to provide summaries of interesting faults and their cures, for the 'Fault of the Month' feature which began in Serviceman about 10 years ago.

It seems that this was due to adverse criticism from a number of TETIA members, who have been unhappy about such information being published in a general-coverage magazine like *EA*. They argued that this made hard-won servicing information available to 'unqualified' people, and therefore worked against the interests of TETIA and its membership — all of whom depend upon servicing for their living.

Not surprisingly, the announcement has produced a response, from a reader in Victoria who's less than happy with the attitude of the TETIA membership. He's Robert Heyward, of Canterbury, and his letter is quite self-explanatory:

Last month's edition of Electronics Australia (April '94) — in particular, 'The Serviceman' column — raised an issue which should be discussed for the benefit of those in a similar position to me. What is a 'qualified serviceman/technician'? I note that Mr Lawler, in his open letter in the magazine, did not go as far as to define what members of TETIA would call 'qualified technicians'.

I can only assume that their definition would be of the order of someone who has studied something akin to electronics servicing at some particular college or school of TAFE and, at the end of his or her study, has been given a small piece of paper to frame and hang on the wall, stating that "the afore-mentioned person may now call him/herself 'qualified' ". Perhaps only those who are members of TETIA (in the militants' view) may call themselves qualified.

By these assumed standards then, I am not qualified. I am, as Mr Lawler would put it, a 'backyarder'. I have been in the business (although part-time) of electronic servicing for nearly eight years. All that I know about electronics and the building and servicing of electronic equipment was either self-taught (i.e., book reading, experimenting) or learnt from my father, who has been in the business of poking inside televisions and knitting mills for around twenty-five years — and can be called 'qualified'.

So, I have had no formal apprenticeship, no study at an appropriate college. Yet I know my way around inside most consumer electronics equipment, am ably capable of repairing, or at least diagnosing, faults in this equipment given a soldering iron and a circuit diagram if necessary. But I am one whom the Electronic Technicians Institute of Australia would class a 'backyarder'.

I am most definitely not the only electronics enthusiast in this situation. I can probably guarantee that a large proportion of the population of electronics technicians may not be called 'qualified' in the eyes of some members of TETIA. So what are we — simply 'amateur technicians' who would have no hope in Buckley's of finding a job in the industry, not because we are lacking in know-how, but lacking in credentials?

For example, what would happen if someone in Government (and probably with no idea) decided that only 'licensed' technicians would be allowed in business. As far as I know, this idea has been kicking around for a while, and, I'm sure, with a large number of technicians against it. How would you obtain a licence?

If you are 'qualified' it would be a piece of cake, because you own a piece of paper saying you are allowed to fix things. But how about those who have come the hard way, through childhoods of reading 'Radio, Television and Hobbies' or 'Electronics Australia', building radios and televisions, and then taking the natural step to servicing them — as a good deal of technicians did. How would these people, who may love electronics and their work, be allowed to stay practising if they cannot class themselves as being 'qualified'.

So, what is a 'qualified technician'? I am glad Mr Lawler has a more liberal view than some of his associates, but I would like to know what his associates — and other interested parties — have to say about the matter before anyone charges off and defines a line between the two very subliminal states of qualified and unqualified.

Thanks for those comments, Mr Heyward; they sound as if they're right from the heart, and I can certainly understand your position. Like you I'm not very happy about the attitude of those TETIA members, either, as this kind of 'dog in the manger' approach often tends to spread, and end up with everyone losing. It's also quite contrary to the traditional Australian approach of sharing your skills and knowledge, it seems to me.

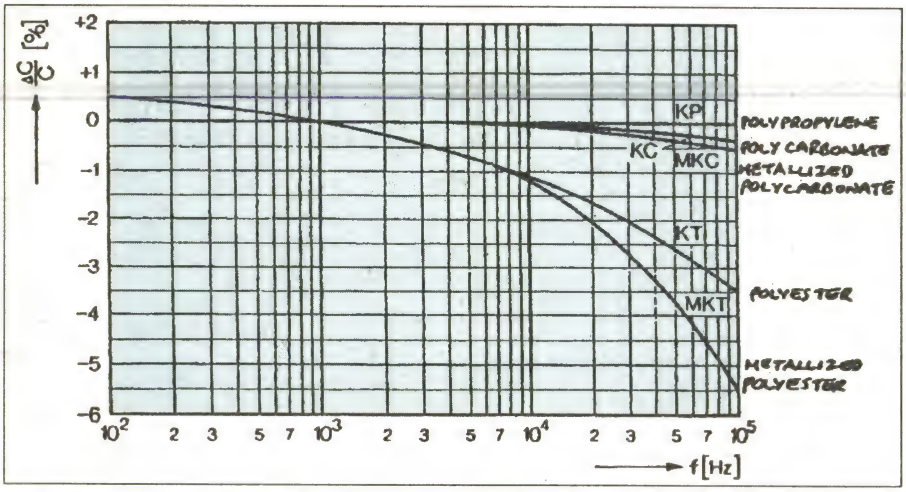
By the way, I suspect you may well have drawn attention to the 'Achilles heel' of the people concerned. If you did a survey of the TETIA members, you'd probably find that quite a high proportion of *them* have little or no formal qualifications, either. A great many people working in the servicing industry got where they are the hard way — by lots of hard work and self training, not by taking formal training courses. And there's nothing wrong with this, of course; experience is the best teacher, and enthusiasm and motivation will always be worth more than 'a piece of paper' in the real world.

You're quite right then, I think, to ask exactly what these TETIA people *do* mean when they talk about 'qualified' technicians. It may *well* be that they really do mean 'members of TETIA', but if so they may well find that their elitist approach eventually works against them. As you point out, there's quite a push from consumer protection organisations for technician licensing, and if this happens the official definition of 'qualified' might turn out to exclude many TETIA members, as well as some 'backyarders'.

I imagine other readers might well have interesting views on this subject. If so, please write in and share them with the rest of us.

Distorting capacitors

Changing the subject again, I've had another response on the subject of capacitors and the types of distortion they can produce in audio amplifiers — last discussed in the April Forum. This response comes from Andrew Taylor, who is a professional electronics engineer working in the electronic design department of Telecom, in Perth WA. Here's



One of the graphs sent in by reader Andrew Taylor, showing the way capacitance varies with frequency for common types of plastic film capacitor.

what Mr Taylor has contributed to the capacitor distortion discussion:

Having read April's Forum in EA, I thought you may like to add the attached information on capacitors to the fire. The graphs are from the Roederstein Film Capacitors 1990 databook. They are typical of plastic film capacitors, although capacitors from other manufacturers can show up to three times more variation.

Note the frequency dependent capacitance for the polyester types (KT, MKT), the type originally generalised as 'greencaps' in the industry. Although the percentage change over the audio band is only around 1% in these diagrams, it can be up to 3%.

This non-linear effect would definitely introduce small but quantifiable distortion in bandshaping circuits (tone controls). It would also cause the reported results in the Jung/Curl test, since the RC constant at specific frequencies would be different (inconstant!) between different capacitor types, even if the capacitors are accurately measured to have the same value at a single frequency (typically 1kHz).

However, in audio amplifier circuits designed to have a flat pass band, the in-band effect would be negligible. Using a coupling capacitor for example, consider that for in-band frequencies, the capacitor's absolute impedance is very small compared to the load impedance presented by the next stage. If this condition is false then the amp isn't in its pass-band, by definition.

Now, any frequency dependent variation of the capacitance must be reflected in the capacitor's impedance. Since this impedance is already negligible, though, the 30-100 times smaller variation will be insignificant in absolute terms, and so will the consequent frequency distortion of signal amplitude.

For tone-control circuits, you could use polycarbonate or polypropylene film capacitors to eliminate any deviation from the desired distortion characteristic. But for coupling and general passband control the 'greencap' lives on! You would need a good imagination (probably a normal result of the brain-distortion caused by the weight of 'golden ears') to hear any significant difference otherwise.

Thanks for those comments, Mr Taylor, and I'm reproducing the graph you included which shows the capacitance versus frequency characteristics of various common types of plastic film capacitor. As you say, the change over the audio range can be quite significant — although how much distortion this may produce will depend very much on the circuit configuration.

I'm fairly sure you're right, that distortion is only likely to be produced in tone control and other filter circuits, where a capacitance change can have a significant impact. It isn't likely to be produced by capacitors in coupling and bypass positions, because as you say their impedance is generally arranged to be very much smaller than the load or other relevant circuit impedances.

Irresponsible Australia?

And to finish off this month, here's a little item sent in by reader Colin MacKinnon, of Glenhaven in NSW. We in Australia like to think of ourselves as environmentally responsible, and look with some disdain at countries which produce a lot of pollution or take what we regard as insufficient care when it comes to disposing of toxic materials. But it looks as if we're not in a position to be too self-righteous, if this item spotted by Colin in a shipping newspaper is to be believed:

SIEZURES & ARRESTS: GAMZAT TSADASA (Russian)

Manila, Mar 2 — M container vessel Gamzat Tsadasa, reportedly carrying toxic waste from Australia, was prevented from unloading her cargo in the Philippines, which environmentalist groups say has become a dumping ground for industrialised countries, officials said today.

The vessel docked in Manila last night and was about to unload two 40-foot container vans containing computer scrap when Customs agents intervened. Greenpeace, the environmental watchdog group, said the shipment was the latest example of how the industrialised world has been violating national and international laws by dumping hazardous materials in Asia.

Sen Orlando Mercado, who inspected the vessel with Greenpeace officials, asked authorities to impound the vessel until an inspection by the Department of Environment and Natural Resources is completed. The vessel will be sent back to Australia if her cargo — labelled 'mixed electronic metal scrap' — is considered hazardous waste under Philippine law, Mercado said.

In a statement, Greenpeace said the computer scrap is among the most lethal forms of industrial waste. It contains chlorinated compounds and heavy metals, which produce 'large quantities of dioxins' when processed. — United Press International.

Well, there you are. Did *you* realise that Australia was sending hazardous and toxic electronic scrap materials to the Philippines, for either dumping or reprocessing? I didn't, I have to confess, and if it's true it doesn't sound such a good idea to me. But what do you think?

Colin MacKinnon says that from a photo published, the goods in question appeared to be mainly computer monitors, with some power supplies, keyboards and PC cases — of the 'XT' vintage, he suspects. He comments that like most of us, he didn't realise his old PC was 'among the most lethal forms of toxic waste'. Now he *does* know, he's wondering whether he will need to bury it in his backyard, along with those old radios no-one wanted...

Of course if we *can't* ship our hazardous waste 'somewhere else', that means that we'll have to work out ways to reprocess or dispose of it safely, ourselves.

My thanks to Colin MacKinnon for drawing our attention to this, and I hope to see you here again next month. ❖

When I Think Back...

by Neville Williams

Howard Kingsley Love: From pioneer VK3 amateur to equipment manufacturer - 1

Some readers will remember Howard Kingsley Love as a pioneer radio amateur who entertained Melbourne wireless experimenters prior to the commencement of official broadcasting. Others may remember him as the man behind wartime products like the Kingsley AR-7 communications receiver. To still others, he will be recalled as a manufacturer of ferro-magnetic components and, in particular, the Ferrotune system which obviated the need for a tuning gang.

As will be apparent, this article follows as a natural sequel to our biography of Lay Cranch. In the taped interview on which that story was based, Lay set considerable store by his early association with Howard Love and left little doubt that his involvement in the Kingsley Radio enterprise was his most memorable technical responsibility.

It also transpired that George Neilson (VK3TES), who supplied a transcript of the abovementioned interview, was himself a long-term employee of Kingsley Radio, such that he was able to send me a draft account of his own period of service in their factory, much as published in *Amateur Radio* magazine for June, July and August 1993.

There was too much material to cram into one article and, to do so would, in any case, have done less than justice to the Kingsley story. But it raised another problem in that while, over the years, I had noticed numerous references in radio literature to Howard Kingsley Love, I could not recall ever having seen a collated account of his earlier years.

I may have missed something, of course, particularly if it appeared in a domestic VK3 publication, several of which came and went during the late 1920's. For the present, I can only do my best with the information to hand.

It is evident that, by 1923, Howard Love had won sufficient acceptance by Melbourne's notable wireless pioneers, to serve several terms as the WIA (Wireless Institute of Australia) Victorian and/or Federal President.

He was subsequently named as an honorary life member of both groups and, at an engineering level, became a member of the IRE (Institution of Radio Engineers).

Radio historian Colin MacKinnon (VK2DYM) confirms that Howard Love held an Experimental Wireless licence XOW at the outbreak of WW1 (1914), suggesting that he would most likely have been born in the mid 1890's. At the time, the Love family were in the timber yard business and subsequently took advantage of his somewhat incongruous interest by marketing timber poles for wireless aerials.

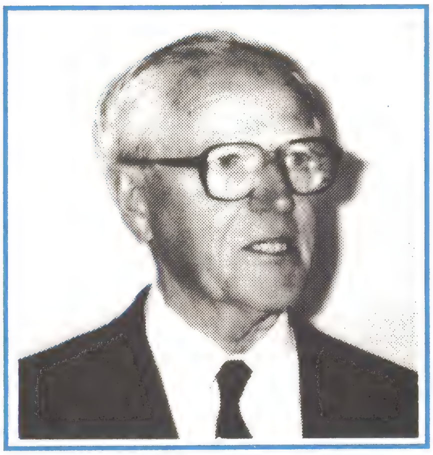


Fig.1: George Neilson, VK3TES, who provided an original draft on which this instalment is based. (Picture from 'Amateur Radio'.)

Howard served in the first AIF from 1915 - 19, rising to the rank of Major before transferring to the Royal Flying Corps, where he trained as a fighter pilot.

Shot down behind the enemy lines, he ended up in a POW camp. Postwar, Howard retained an interest in aviation, flying Hawker Hart fighters as a member of the RAAF Reserve — a role which gave him a degree of access to the military 'establishment' via his wartime 'cronies'.

Howard Love was also allocated the callsign A-3BM (later VK3BM and VK3KU), when amateur transmitting privileges were restored after the war — a practical outlet for his technical inclinations.

An article in the April 1923 issue of *The Australian Wireless Review* tells how Messrs Hull (VK3JU), Holst (VK3BY) and Love (VK3BM) had all recently installed new low power (6W) telephony transmitters. Over distances up to five to six miles (eight - 10km) they reputedly provided signals comparable to those from earlier quarter-kW installations.

To assess their performance over greater distances, Mr H.W. Maddick, Hononary Secretary of the WIA Vic, visiting Echuca on vacation, had reportedly set up a one valve portable receiver with a 25-foot high antenna slung between two trees. Clear voice signals were received from all three of the above stations by night and day.

Howard Love's transmitter was said to be typical: a 5W BTH valve with 400V on the anode, obtained from a mains power supply using a power transformer, electrolytic rectifier and conventional

L/C filtering. The filament was operated from a centre-tapped transformer, the oscillator being grid modulated and the output fed to an umbrella type aerial, 70 to 80ft (21 - 24m) high.

'Public' transmissions

Comment in the article suggests that, while such collective concentration on telephony was relatively recent, it was an indication that Melbourne amateurs, as a group, were determined not to be left behind in providing 'broadcast' style transmissions for eager experimenters/ listeners.

A second article in the same April '23 issue was by a staff member who had been despatched to Melbourne to report on amateur preparations to transmit broadcast style programs. Amateurs, he said, including those above, were currently devising a roster which would ensure that a program of speech and music would be available each evening on a wavelength of 440 metres.

The schedule, which was due to be implemented within a few days, took account of the Sydney transmissions and operators would encourage listeners to send reception reports to all stations which they had been able to receive and identify. Importantly, the broadcasts were not to be at the expense of traditional amateur type communication. A paragraph in *The Australasian Wireless Review* for November 1923 reads:

> ***Mr Hull, the Melbourne experimenter (recently) logged 26 American Amateur transmitting stations within one hour, and Messrs Holst, Howden, Love, Israel and Cox have also 'bagged' quite a number. Mr Love received two complete messages sent direct to him by the Radio Journal of California. Mr Hull had transferred his set to Mr Love's residence to join forces with him in the (coming) Trans-Pacific tests.***

According to the April 1923 issue of the same magazine, personal messages from Long Beach, USA to Howard Love had to do with the fact that, as Victorian Divisional Chairman, he had supported moves to set up the trans-Pacific tests 'by writing to a number of clubs on this coast'.

It had been agreed, incidentally, to suspend amateur broadcast-style transmissions for the duration of the tests, to clear the airwaves for trans-Pacific communication. (See also the Ross Hull story, in *EA* February 1989, page 22.)

The tests established once and for all the viability of modestly powered shortwave telephony across the Pacific. But Howard Love had yet another interest.

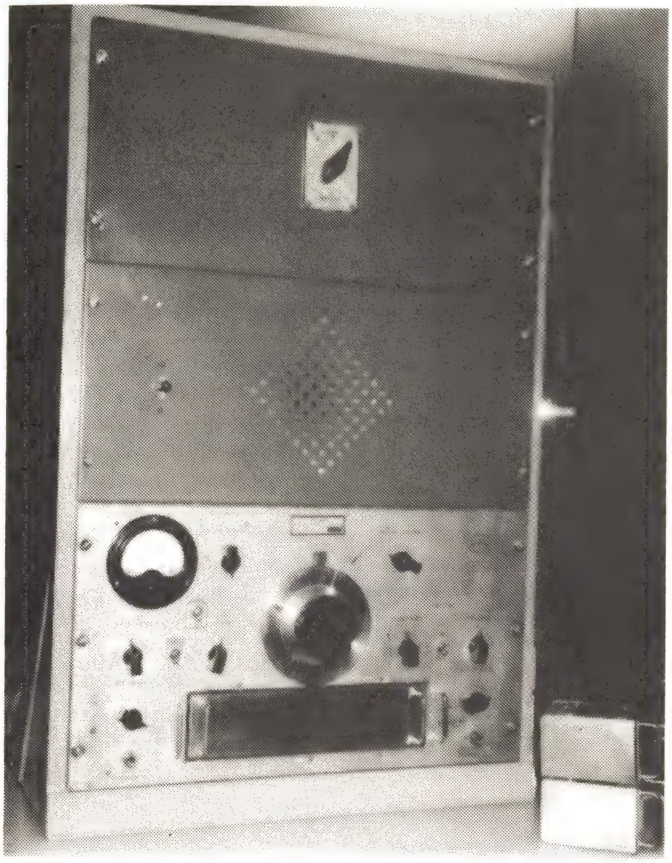


Fig.2: A rack mounted RAAF version of the AR7 receiver with loudspeaker and power supply, about a metre high. Reconditioned by amateur radio volunteers, it is displayed in the Scienceworks Museum, Victoria.

H.K. Love — publisher

In *EA* for April 1992 (page 46), by courtesy of Colin Mackinnon, I summarised moves in the technical publishing field which led to Howard Love also becoming involved in *that* area during the 1920's.

Back in 1923, AWA's popular science magazine *Sea, Land and Air* was restyled and re-issued under new management as *Radio in Australia and New Zealand*. As part of the revision, routine reports from individual WIA Divisions were replaced by general amateur notes compiled, by the then newsworthy Charles Maclurcan.

In that form, the magazine was taken over by Wireless Newspapers Ltd in 1925, becoming a virtual stablemate of our own ancestor *Wireless Weekly*. The title was effectively reduced to *Radio* but, despite promotion, it ceased publication in December 1928, being officially 'absorbed' by its more vigorous companion.

However, with *Wireless Weekly*'s programs, personalities and technicalities all slanted towards broadcast listeners, the amateur fraternity felt even further disadvantaged — the WIA in particular lacking a committed outlet for Divisional Notes.

Right at the outset, in 1923, the Victorian Division had considered publishing its own official *Proceedings*, but ended up with a less formal 32-page magazine entitled *Radio Experimenter*, edited by its President Howard Love and with Ross Hull as Technical Editor.

In May 1924, at the first Australian WIA Convention in the Melbourne Town Hall, a plan to adopt the magazine as the official national journal lapsed. Without sufficient financial support, it was surrendered to its commercial printer and re-styled as a wireless retailing journal, only to cease publication anyway in June 1925.

Not to be deprived, the Victorian Division started yet another publication in 1924 entitled *Experimental Radio Broadcast News*. In the following year, it was renamed *Radio Broadcast*, the responsibility of the WIA (Vic) Publishing offshoot, with Howard Love as Managing Director and Ross Hull as Managing Editor.

It had about it the hallmarks of a determined effort, and was formally adopted by the second National Convention (Perth, 1925) as the official national organ of the WIA.

But it was not to be. The venture suffered from disruptive changes in location and personnel, and in 1927, Ross Hull headed overseas to seek and accept a position with the ARRL (American Radio Relay League) — an appointment that brought both international recognition and ultimately a tragic death by electrocution.

Radio Broadcast lapsed in January of

that same year, and state divisions resorted to their own home-grown bulletins during 1927 - 9.

To further complicate matters for the WIA, the rival 'Amateur Radio Transmitters League' was formed. About this time, it would appear, Howard Love finally abandoned any aspirations he might have entertained to become a publisher.

Love the engineer

According to last month's biography, it was also about this time (1929) that a 19-year old amateur, Lay Cranch, entered the radio industry.

After working for few months at the Edison Shop in Melbourne and later at Brashs, he found himself in the lab at Firth Bros, as the personal assistant to their resident engineer — none other than Howard Love.

Whether Lay had known Howard Love beforehand is not clear, but he was certainly flattered by the appointment. He goes on to say how they jointly developed a successful mains powered superhet which, if not the first, was certainly among those which ushered in the '1930's-style' genre. This was around 1931.

From Firth Bros, they both moved to Radiovision in St Kilda Road, Melbourne and as described in the last issue, developed what was claimed to be the first mass-produced autodyne type superhet using mains type pentode valves.

However, when Radiovision subsequently decided to re-locate and concentrate on the 'vision' aspect of their business, Lay Cranch resigned and, as previously noted, spent the next six-odd years as Chief engineer of Essanay in South Melbourne.

What happened to Howard Love during this same period, Lay does not say; but it would appear that he established his own independent radio factory. Although this is not listed in Mingay's *Radio Trade Annual* in the late 1930's, Colin MacKinnon gives the start-up date as 1931.

Fortunately, the personal memoirs of George Neilson, VK3TES, go a long way towards bridging the gap. They also indicate that Kingsley's success with Ferrotune technology was a much more protracted exercise than might be deduced from the Cranch interview. (For those who may have known George personally during the relevant period, he can be reached at 48 Garden Street, Blairgowrie, Vic 3942; phone 059 889 171.)

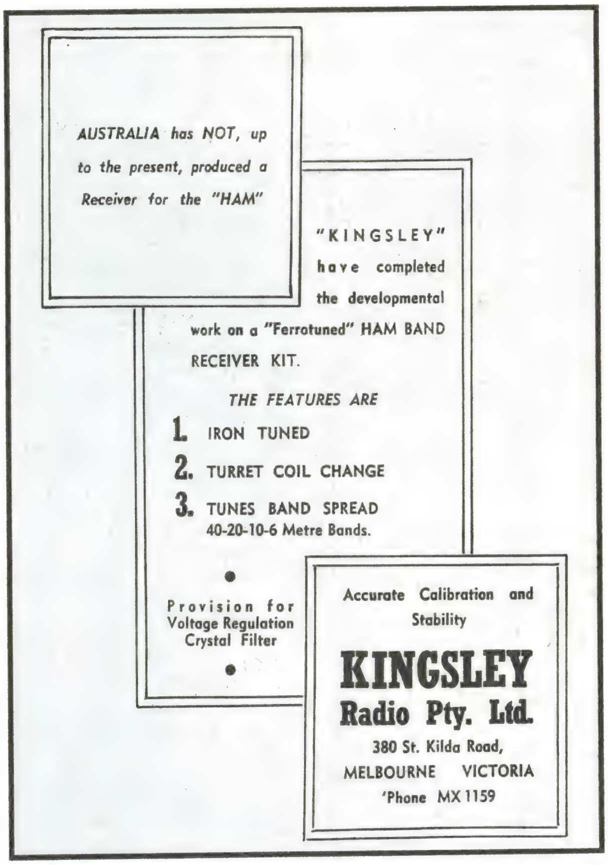


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Fig.3: To the best of our knowledge — a receiver that never was! Advertised in Mingay's 1947 'Technical Topics Radio Handbook' it was scheduled for production about the time that Kingsley Radio was 'wound up'.

George says that his own interest in radio began in the mid-1920's at age 8, when his father brought home a crystal set. George poked around inside it but, while he didn't learn much, it still stirred his curiosity. At age 14 (1933) he completed his schooling to year 10 at Northcote High, his education being fortuitously rounded off with a fill-in hobbies class covering the rudiments of radio.

In early 1934, George managed to obtain an interim job at a local hardware store, which provided him with the means to buy a few radio 'bits and pieces'. His main interest at this time was in amateur radio stations which, he said, "often popped up on the broadcast band on Sunday mornings".

His interest was shared by a scout colleague by the name of Ron Pollock and the two pooled their resources to build their own shortwave receiver.

Manufacturer and explorer

Ron had gone one better, by signing up with a Melbourne business college for their radio course. It transpired that the college had sub-contracted Kingsley Radio to provide coaching, which took the form of on-the job training in the Kingsley factory, in Spring St Melbourne, supervised by factory staff.

In the process, Ron Pollock obtained a full-time job with Kingsley, and when George's own employer decided in 1938 to 'shut up shop', Ron alerted him to a vacancy in the Kingsley factory.

Thinking back to 1938, George recalls that the Managing Director was Howard Kingsley Love, universally referred to as 'HK'. He was widely known in the trade, as well as being an active amateur radio operator with the callsign VK3KU. (Earlier references show his callsign as VK3BM, confirmed by the *Wireless Weekly* Callsign Supplement published on July 18, 1930).

George says that HK's secretary at the time was a personable lass with the Irish sounding name of Mollie Malone; while his Chief Designer was Jack Gostalow, who was later to join AWA.

The field serviceman was Johnnie Bremner who, much later, went to Ross Morris in South Melbourne; and the Foreman Norm Connell, who subsequently set up his own business making taxi meters.

Other Kingsley old-timers whom George recalls from the late 1930's include Brian Irwin, Max Downes and his brother Charles and Harry Fuller (VK3HF), who left just before George joined the staff.

Harry had gained his commercial 'ticket' and went to work for 3SR Shepparton, subsequently moving to 3YB at Warrnambool as Chief Engineer. His next paragraph came as something of a surprise:

H.K. Love and Harry Fuller were notable in that they went on the Donald McKay expedition to Central Australia in the 1930's as radio operators. This expedition was noted for the first use of both radio and aircraft and has been referred to, rightly or wrongly, as 'The Last Great Expedition in Australia'.

'Direct coupled' amps

Therein obviously lies another story. But, back to electronics, George Neilson says that, during the 1930's, Kingsley Radio had built up a reputation 'amongst the gentry who were so inclined' for high fidelity radio — employing what was then a 'hot potato' in the industry, namely direct coupling. His favoured configuration for hifi models used a 2A3 power triode, with its grid connected directly to the anode of the preceding voltage amplifier.

That made me sit up, because it was the very subject that kick-started the 'Let's Buy An Argument' column in this magazine, which was later dignified with the present title 'Forum'.

In its most convincing form, the 'Loftin-White' circuit used a type 50 high powered triode, with its grid connected directly to the anode of the preceding voltage amplifier. Because of the high voltages involved, it was a demanding configuration; but the big husky triode delivered more power than was available from less pretentious types or from characteristically distortion-prone tetrodes or pentodes.

Unfortunately, some publicists spread the word that the merit of the scheme rested in the direct coupling, and that 'hifi' could therefore be achieved by merely re-arranging a conventional pentode amplifier to eliminate one inoffensive coupling capacitor. As the late Fritz Langford-Smith showed in A.W. Valve Co literature in the late 1930's, the appropriate answer to the hifi quest lay either in the use of power triodes or the application of negative feedback to power tetrodes or pentodes.

But direct coupling notwithstanding, in his choice of 2A3's Howard Love was handling the 'hot potato' correctly.

In addition to the hifi models, George Neilson says that Kingsley also produced conventional five and six valve D/W mains receivers, and four and five valve battery and vibrator sets "Which were noted for being very economical". Included in the range was also "the odd 32V model" for use with farm supply systems.

On the job training

Although 19 years of age. George says that he started as the 'boy', doing all the menial jobs first and learning the essentials of sheet metal work in between times. At Kingsley, this involved a foot treadle guillotine, hand operated bender and a manual bench-mounted 'nibbler'.

The factory boasted a bench mounted drill, but no punches to cut holes — just a cutter in a hand brace. In the absence of a spot welder, chassies were assembled with bolts and nuts, and spraying effected with the aid of a motor car hand pump attached to a small air tank — this was on a stairway landing, in lieu of a spray booth.

A VERY LONG DOG!

Johnnie Bremner, Kingsley Radio's Serviceman/Engineer, is remembered for the following pearl of wisdom:

"How does radio work?"

"Imagine a very long dog with his head in one country town and his tail in another..."

"Yes."

"Imagine that if you twist his tail in one town, he will bark in the other!"

"You mean to say that that's how radio works?"

"Well it is, if you take away the dog!"

Old-timers may well recognise George Neilson's description as applicable to any number of small start-up radio factories in the early thirties! Similarly, his progress through the pecking order:

From messages and metalwork, George worked his way up to assembly, wiring and (you beaut!) testing. His mentor was the abovementioned Johnnie Bremner, who had meanwhile graduated from Serviceman to Chief Engineer (see panel).

In word and deed, 'Johnnie' was always good for a laugh. At the time, Kingsley were also making diathermy machines — basic but fairly powerful RF oscillators, which were used by the medical profession to create internal heat in various parts of the body, or to speed coagulation in surgical situations.

Johnnie had just finished adjusting one of the machines when his Uncle Fred shuffled in. Down from the country, he had been sampling the service offered by pubs in the area and was somewhat the worse for the effort.

When Johnnie explained the nature of the machine he was working on, Uncle Fred wondered whether it would do any good for his 'crook' (rheumatic) knee. To find out, he was installed in a chair, attached to the various pads and cables and told not to move when the gadget was switched on.

FOR OR AGAINST?

A young recruit was said to have accosted an old soldier outside the Kingsley Radio factory.

"Excuse me Dig, I'm looking for the Victoria Barracks. Can you tell me which side they're on?"

The old soldier thought for a moment, then said:

"I'm not rightly sure, son, but I think they're on ours!"

Unfortunately, Johnnie got involved in something else and completely forgot his uncle. When he finally did remember him, he found him uncomplaining but very red in the face, although it was unclear whether it had to do with his intake of RF or alcohol.

Said George: "I never saw him again, so I cannot report whether his leg fell off, or his rheumatics were cured!"

Special orders

As a small company, Kingsley Radio tended to pick up quite a few special orders in the early days, which provided work and also a pleasant break from factory routines.

For the filming of (as George recalls) *Captains Courageous* with Spencer Tracy, a sloop had to be fitted with two-way marine radio. Designed by Jack Gostelow and built in the factory, it was taken to Williamstown for fitting and proving — which George remembered as a pleasant diversion from everyday factory work.

A rather similar diversion followed when Kingsley was commissioned to provide radio communication equipment for the Melbourne Harbour Trust, to use with and on their fleet of hopper barges, dredges and tugs. Preliminary testing involved setting up a control centre at 'Dockhead' between North Wharf and Victoria Dock, with mobile equipment on the barge *William Cooper*.

Although not a romantic craft, several days spent 'swanning up and down the Bay' in perfect weather were not exactly hard to take!

On another occasion, HK set out to convince the Army that they needed new communication equipment. Prototype portable transceivers were developed and loaded aboard HK's and Johnnie's cars. Between Mt Dandenong and the Mornington Peninsular (respectively) contact was made — but in this case, while the Army were convinced that they needed updated equipment, somebody else got the order.

But all was not lost. The RAAF contracted to buy portable HF equipment, which came to be known as the ATR1; and followed it up with a specification for an Australian-made high performance communications receiver. This was on behalf of the Armed Services.

HK decided to give the receiver his best shot, and George Neilson says that: "We let our heads go. Never have I seen so much effort devoted to the design of a receiver ... with everybody on our team contributing". Detailed design was in the hands of Jack Gostelow, Johnnie Bremner and Norman Connell — with HK looking over their collective shoulders.

Kingsley's KCR-11/AR7

With his background in amateur radio, HK personally decided that their submission would be based on the concept of the well known American National HRO receiver. Designated the KCR-11, it was to become best known as the RAAF's AR7.

Instead of using either built-in switched coils or separate plug-in coils, the HRO coils for each band were mounted in a drawer-like metal case, with internally shielded compartments and contacts distributed along its rear face.

It was designed to slide into a large matching recess along the lower front of the receiver panel, with internal contacts complementing those on the rear of the drawer to connect each of the coils into circuit.

Changing bands simply involved selecting and plugging in the appropriate coil box or drawer.

A graph on the front face of each drawer indicated its coverage and the dial setting for any given frequency within its range.

In the Kingsley version, the box was formed from sheet copper, nickel plated. A set of four coils in each was mounted on a steel front plate, carrying two handles and a stainless steel engraved graph, as above. The normal complement for an AR7 was five coil boxes, one for the range 150 to 430kHz and four others covering from 535kHz to 25MHz.

In terms of circuitry, the design involved two RF stages, a mixer and two IF stages with BFO (beat frequency oscillator) and crystal filter, plus an audio power amplifier. The crystal filter was designed and pre-assembled in house, using crystals supplied by Max Howden (VK3BQ) mentioned earlier. In the field, the receiver could be operated either from the 240V AC mains or from a 12V DC supply.

With ruggedness, precision and stability as pre-requisites, a traditional glass-and-string dial was presumed to be unacceptable. Kingsley, accordingly, arranged for an 'HRO' style mechanism to be manufactured by H. Alger & Sons, who were experienced in precision work allied to the movie projection equipment. The work was later taken over by Messrs Bryant & Hunter, from a similar backround.

Using a precision worm drive, the dial provided 20:1 vernier tuning with twin photo-engraved circular scales offering 500 distinct reference positions.

Successful endeavour

George Neilson says that his personal involvement in the design was detailed layout of the chassis and an appropriate wiring pattern for the prototype.

He adds that the Kingsley submission was accepted by the RAAF. They placed a pilot order for an initial 20 receivers, but this was followed by orders for hundreds more.

The old factory in Spring Street soon become too small and Kingsley moved into new premises in St Kilda Rd, opposite the Shrine and only one block from the RAAF headquarters — now their principal customer.

The RAAF, in turn, was next door to the Victoria Barracks, headquarters of the Army and Navy (see panel 'For or Against?').

(To be continued) ◆

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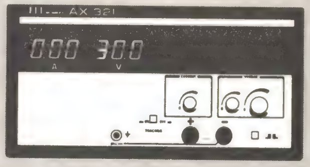

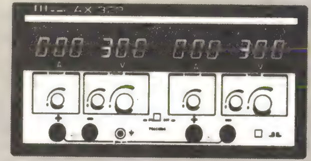

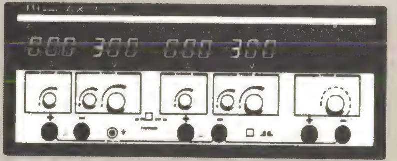

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	LED display of adjusted voltage & output current	LED display of adjusted voltage & output current for ea. unit	LED display of adjusted current for the 30V units
Resolution:	0.1V & 10mA	0.1V and 10mA	0.1V and 10mA
Accuracy:	0.5%	0.5%	0.5%
	Adjustment of Max current between 0 & 2.5A; LED indication of this limit	Adjustment of Max. current for ea. unit between 0 & 2.5 A LED indication of this limit	Output current limitation for the 30V unit w/LED indication For the 5V unit; LED indication of the 5A limit
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READER INFO NO. 13

THE SERVICEMAN

Awkward problems in all kinds of unfamiliar pieces of equipment...

The stories I have for you this month are very much out of the ordinary — nothing as mundane as a dry joint or dried-out electro here. There's a really awkward problem in a pipe organ, a simple but elusive problem in (of all things) a gas chromatograph, and a couple of tricky problems with aircraft radio gear.

This month I have chosen to present some readers' stories about subjects that have never appeared in these pages before.

I don't know about you, but I have always been interested in finding out how things work — even things that are really no concern of mine. The following contributions enlightened *me* about their subjects, but didn't really fit in with the topics usually presented in these pages. So the stories have been sitting in my files, waiting until I could find an excuse to present them here.

But now, I've decided that they *must* be told. So they come together this month, in a collection that might well be given the title 'Far Out'!

Personally, I was fascinated to learn how the devices work, but at the same time grateful that I have never been called on to service this kind of gear. See what *you* think...

The first, and longest story comes from P.S., of Dunedin in New Zealand. As you will see, P.S. was more or less forced into tackling this job, and the fact that he succeeded is a tribute to his versatility. Here's what he has to say:

The story that follows details my amateurish efforts to service the large pipe organ in Knox Church, Dunedin, where I am the assistant choirmaster. Beside music, I have long had an interest in electronics and have built a number of high-quality audio amplifiers over the years, along with assorted other projects. As do many with similar interests, I find that various little electronic problems tend to be diverted in my direction. This one is unquestionably the largest and most bizarre.

The problem concerned the failure of part of the 'action' of the organ and in order to explain things, I need to describe some aspects of pipe organ design.

Pipe organs usually have two or more keyboards, of 61 notes each and a pedal board of 30 or 32 notes. Each keyboard controls a separate division of the organ so that contrasting sounds can be used either together or in rapid succession. The pedal board also controls its own division — usually containing the deep bass notes.

The connection between a keyboard and its division (called a sounding board or chest) is via the key action, which has variously been mechanical, pneumatic or electro-pneumatic. Obviously, since this is an electronics journal, this story concerns the latter system.

In the electro-pneumatic action, depressing a key closes an electrical contact, energising a solenoid in the action. The solenoid moves a small armature, allowing wind to fill or exhaust a small pneumatic 'motor' (bellows) which in turn allows an intermediate motor to fill/exhaust, which in turn allows a large motor to open a large valve (called a pallet), to allow air into the chest, or into an individual pipe, as appropriate.

This cascaded arrangement has been developed to allow the rapid opening and closing of wind valves by the use of modest DC currents and voltages. Actions typically use 12 - 15V at some 20 - 30 amps for medium sized organs. Details of the mechanisms vary, reflecting the work of different builders and different periods of construction.

In order to allow greater flexibility in performance, mechanisms (called couplers) enable one division to be played from another so that in order to produce the greatest sound, all keyboard divisions would be coupled to one keyboard (the Great) and all pedal divisions coupled to the pedal board.

To complicate the issue still further, it is common for one of the divisions (the Swell Organ) to have octave couplers that allow upper and lower octaves to be sounded simultaneously, with the further option of omitting the Unison by the use of the Unison Off coupler.

Thus, for a typical three manual organ with Great, Swell, Choir and Pedal divisions, a fairly standard set of couplers would be Swell to Great, Choir to Great, Swell to Choir, Swell to Swell Octave, Swell to Swell Sub-octave, Swell Unison Off, Swell to Pedal, Great to Pedal and Choir to Pedal. Octave couplers could be applied to other divisions, but they are not always necessary nor are they included.

Another feature of many pipe organs is the sharing of some pipe ranks between divisions. For example, the 16' Echo Bourdon on the Great may also be present as a 16' Echo Bourdon on the Pedal, by way of economy. Similarly the Great 8' Trumpet may be extended down to provide a 16' Trombone on the Pedal

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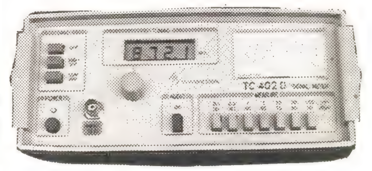

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division. (The lengths 16' and 8' refer to the pitch of the ranks, with 8' being the same as that on a piano, 16' an octave lower.)

The logical complexity of controlling this combination of couplers and extended/borrowed ranks was long handled by the use of multi-contact key switches (typically with six to eight contacts per key) and multi-contact gang relays (with 61 contacts per relay).

However, in the late 1960's and early 70's the use of solid state logic began to appear in what is really a rather conservative trade. (Incidentally, despite the advent of electric actions in the late 19th century, many aspects of organ design remain little changed over the last 500 years!)

The organ which is the subject of this report uses an early form of electronic logic, with about five large (500mm x 500mm) PC boards containing an assortment of discrete diode-transistor logic. The boards are mounted in a varnished hardwood case which happens to be well out of public view, buried beneath the Swell Box (which encases the Swell organ — foot operated louvres on the front of the box provide the swell effect).

The system had worked well for some 17 years, after an initial teething problem with earth potentials had been resolved by attaching a length of wire to each of the earth rails on the PC boards and twisting them together — it still remains so.

The problem I'm writing about was the loss of the couplers to most of the organ, with the exception of Choir to Great, over about half of the manual compass (range). This severely reduced the convenience of playing the instrument, and also chose to happen early in the week before a guest organist was to play for a special large choral service.

'Too busy — sorry!'

The organ builders were called (they are based some 200km north of here) but they made it clear that they felt they were too busy to respond to the call before the weekend. Thus it fell to me (the electronically orientated assistant choirmaster) to sort the thing out!

This month's first contributor, P.S. of Dunedin, NZ, sent this picture of the pipe organ in Knox Church which he found himself having to repair at short notice.

I should explain further about the layout of the organ: the console is downstairs, while the organ is in two sections on either side of the gallery upstairs. As I mentioned earlier, the action logic is located under part of the organ and is accessible from upstairs by squeezing down through a narrow gap and crawling on hands and knees under the supports for the swell box.

There is not much room either above or around the box containing the circuitry. Meanwhile, the key switch which turns on the blower and the DC supply is located downstairs, on the console. Since I had no assistance for most of the time, I expended much sweat running up and down stairs and climbing in and out of the confined space.

The circuit diagrams provided in an envelope of documentation were far from complete, indicating in a few simple figures the notional way in which the system worked, rather than how it was actually configured and connected together.

When I rang the organ builders to see if they could enlighten me, they responded "...well, all the circuits are really much the same thing repeated over and over again. You shouldn't really need many details". This was fine for them. They had actually worked on the things before and probably under much less trying circumstances.

So, back under the swell box, I opened the varnished hardwood case and looked at the circuit boards (after untwisting the wires that sorted out the earth potentials) and examined board after board of closely packed discrete logic. Fortunately, they had been labelled with ballpoint pen on sticky labels and I could establish that the couplers spanned two boards and that the inputs were taken through buffering stages, also labelled at one end of the boards.

The division between the remaining working coupler and the rest corresponded to the division between the boards, so I had localised the fault onto the main coupler board. It might have been easy to isolate the actual fault if I'd had an assistant who could play notes and pull stop handles to my requirements — unfortunately, the only assistance I had was for long enough to test out that the stop handle switches all fed into the buffer stages on the board — then I was on my own.

The main coupler boards also received inputs originating from the key switches for each keyboard note, where upon the signals entered a closely-packed cascade of diodes, small signal transistors and resistors, eventually finishing in a TO-5 encased driver transistor which energised the wind chest solenoid.

I noticed a string of three forward-biased diodes, connected between a rail which traversed right along the board and the 0V ground rail, apparently to provide a 1.8 - 2V reference for the logic. I also noticed that the fibreglass PCB beneath these diodes showed minor evidence of heating, although only to the extent that the surface texture of the board had changed.

I made a few attempts to reconcile the skimpy printed documentation with the tightly-packed componentry, but with little success. I also made several trips out from under the swell box, downstairs to *the console to jam keys down with pencils in the hope that I could trace the logic across the maze on the board.*

This didn't get me very far, so I turned everything off and rang the organ builders to seek advice and inform them of my observations so far. They replied that it was probably the 'half volt rail' which was wrong, so I should check that. I would find it on the terminal panel on the wall, which supplied DC to the whole organ and it should be connected onto all the logic boards.

Back to the church, up the stairs, down under the swell box again. I found the half volt rail and it seemed to measure 0.6V — a single forward biased diode — but it was not connected in any way to the coupler board.

Clearly the half volt rail was a red herring, but it did prompt me to measure the voltage across the series of three diodes. There was no voltage present so I thought BINGO!! — success at last.

I picked up a bag of 1N4007 diodes from the local electronics store, then back under the swell box and desoldered the first diode. It broke in two under the slightest pressure, as did the other two. This made me a little suspicious, since diodes which cracked in half would generally be open, not shorted — so that I should have measured the supply voltage, rather than zero volts across the string.

However the broken diodes needed to be replaced, so I soldered in replacements and tried the thing out. Miraculously, I had repaired the fault — the couplers now all worked, with the exception of a couple of notes. I replaced the equivalent diodes on the second coupler board, since they displayed similar evidence of heating. But before doing so I measured the voltage across them — zero volts! Yet the couplers on this board worked!

I eventually decided that the diode chain only dumped current when the organ was actually being played, with stops and couplers drawn and keys depressed. Without these there was no voltage present to forward bias the chain to around 2V. So, it was a combination of astute physical observation and luck which led me to replace the faulty components and repair the problem.

The missing notes turned out to be blown driver transistors, which had been shorted by one of the trailing earth wires which had brushed across the board while I was swinging it out of the case. When I told the organ builders about this, they said that they always turned off the power before opening the case, to avoid such a problem.

All very well for them! They always work in pairs, so that someone can stay down at the console and switch the power on and off on demand. I would have exhausted myself running up and down stairs to do the same all alone.

The blown transistors were easily replaced with equivalents and the instrument performed perfectly for the guest organist, a consequence of the most challenging and physically exhausting maintenance job ever to come my way.

Not to mention that it was the largest and most expensive appliance that I have ever repaired!

Thanks, P.S. I'm sure that there are few if any of our readers who have tackled a service job as big or as expensive as that one. Thanks also for the explanation of how the organ 'works'. It's one thing to see an organist hammering away at the keyboard; it's quite another thing to know about all that's going on behind the scenes.

JUST FOR A LAUGH!

The old gentleman leaned out of the window of the house next door, watching us prepare the antenna for mounting on the roof. "They should'a got them electricians in!" he shouted.

"Silly old sod!" muttered Keith, as we kept on working.

The job was in Toogooloowah, a little country town in South East Queensland. The customer had just bought the house and had engaged us to move her antenna, a 30-foot roof mount, from her old house to this one.

The old gentleman next door sucked on his pipe and watched us. We put the roof plate on, set up the guy wires then Keith put his foot on the bottom of the mast. I said a little prayer and we raised the 30-foot mast upright. I yelled to Keith "I'll hold it up while you tie off the guy wires".

"OK!" said Keith. Then I slipped. And with all the grace and majesty of a huge tree being felled, the 30-foot mast slowly toppled over and fell off the roof, totally wrecking the antenna.

Keith slid down the roof, over the edge, and hung from the guttering by his fingertips.

"I told 'em they should'a got them electricians in!" the old gentleman shouted.

(Contributed by John Gill, Lowood TV and Video Repairs, Lowood Qld.)

Chromatograph fault

Now, from the hallowed precincts of Knox Church, we pass on to the busy interior of a large scientific laboratory. This story comes from G.J., of Capalaba in Queensland. It's not a long yarn but is quite interesting, nevertheless.

I am employed at a large analytical laboratory as a service technician, doing maintenance and repair on a wide variety of electrical/mechanical equipment. Recently I encountered a problem with a particular piece of equipment which I thought demonstrates how sometimes a simple cause can have quite puzzling symptoms.

The instrument concerned was a gas chromatograph, or GC for short. Basically, this instrument consists of an oven (with a fan to distribute the heat evenly), an electronics chassis to control various functions and to provide signal processing, and one or more detectors.

Into the oven is placed a column, which is a thin hollow coiled tube with a microfine bore. This is heated to between 200 and 300°C and the sample to be analysed is injected into one end and transported to the detector at the other end by a carrier gas, usually nitrogen or helium.

As it passes through the column, the sample separates into its basic components and these arrive at the detector at different times. The resulting plot of signal versus time (the chromatogram) aids in the identification of the sample.

Now, back to the problem.

I received the message that the GC was tripping the overload breaker on the wall. This was occuring at the instant the instrument was turned on, so it had to be something fairly obvious. I suspected it was either a faulty oven element or the fan motor, as these have given trouble in the past.

After removing the rear panel and disconnecting the element, the power was switched on and the GC sprang to life. However, a check of the element showed neither short circuit nor leakage.

The element was then reconnected and the fan motor disconnected. When switched on, the GC again powered up with no tripping of the breaker. At this point a check of the fan motor revealed no problem. What could I be overlooking? With the element AND fan connected, the breaker would trip. Yet with either one out of circuit, there was no problem.

A closer look inside the oven seemed like a good idea at this stage. At first, everything seemed to be in order, but then I spotted a small, metallised adhesive label partially stuck to the floor of the oven. Suddenly, I realised what was going on.

This label had fallen off a column, and was being flipped up by the circulating air and shorting the exposed oven element coil to the chassis. Burn marks on *the edge of the label confirmed the fact. This, of course, explains why both the element and the fan had to be on for the fault to occur.*

That's one fault I won't forget for a long time, though I doubt it will ever happen again, to me!

Well, G.J., I agree that you may never see that problem again, but those metallised labels are very common and sooner or later someone is going find themselves in a situation very like the one you have just described. Thanks for the warning.

Thanks, too, for the explanation about how a GC works. I've heard of the machines often enough, but have never been in the position where I could get an explanation about what they did or how they did it. Now I know...

Avionics problems

We go overseas again for our next contribution. To Mt Hagen in Papua New Guinea, no less. It comes from D.J., an avionics specialist.

D.J. gives us two short stories, the first of which explains the operation of a particularly esoteric aircraft instrument:

I spend all of my days servicing aircraft radios, communication and navigation equipment. A bit different to the TV and video market.

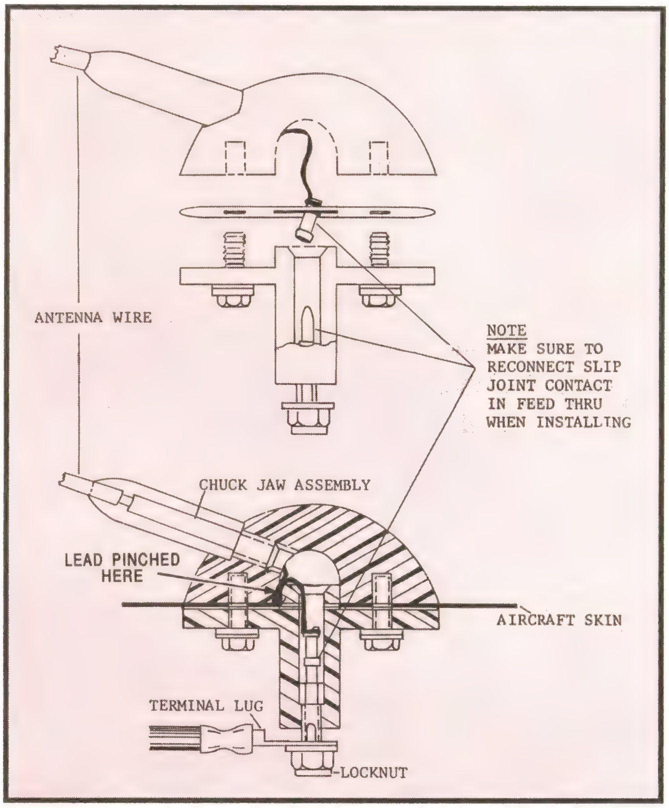
One of the strangest faults recently involved an automatic direction finder (ADF). These use three antennas, one vertical picking up the electrostatic component of the radio wave, and two loops at right angles, picking up the magnetic component.

The amplitude and phase of the loop signals changes with the angle of the signal and the receiver processes the compound signal to drive a motor, which turns the indicator needle to point to the transmitter.

The antenna housing, with its three elements, can be fitted to the bottom of the aircraft, where it may be hit by stones on the local airstrips, or on the top — where it can pick up energy from the HF longwire antenna above and so burn out the receiver pre-amplifiers. In this case I had fitted it underneath the aircraft as the lesser of two evils.

The alternative mounting reverses the phase of the signal, so there is a jumper that can be set for top or bottom mounting. I was sure that I had set the jumper properly, but here I was, looking straight out of the cockpit window at the beacon and listening to its Morse ident, yet the needle was surely pointing behind me!

I rechecked it, turned it on and off, slewed it with the test switch, but there it was, still behind me!



PNG contributor D.J., sent in this diagram to illustrate his story about an elusive problem with an aircraft transceiver antenna which wouldn't load correctly.

I took a short break and as I returned to the aircraft, I noticed that the ground power unit, a 28V 500A supply, was plugged in with about 50 metres of cable going back to the 415V outlet.

Sure enough, disconnecting it restored everything to normal. The power lead was carrying a hefty RF signal, obviously of the opposite phase and it was overpowering the sense antenna. It took a while to find that fault, but I wish they were all as easy to fix.

My next story was a little more embarrassing. The pilots of a newly purchased aircraft reported that the HF transceiver was getting very poor signal strength reports.

I checked it and found the output power was normal and the automatic antenna tuner was indeed resonating, with zero reflected power.

The next week they had the same story. I changed the transceiver and power amplifier, but found a problem in the tuner. This model uses a grounded antenna, effectively a loop with the airframe as one side of the loop; it is preset for a particular antenna length by jumpers on the connector.

The jumpers were obviously wrong, so I rearranged them. But then I found that no combination would persuade the tuner to find a satisfactory position.

Not being a great lover of automatic tuners (they have a lot of faults) I got to the stage where I tore out the whole system and replaced it with a well known and trusted Australian unit (unfortunately no longer in production due to low market demand). This antenna tuner uses an insulated long wire and is easy to tune. But this one wasn't! It was quite unable to tune the revised antenna.

Finally, I measured the antenna resistance and found it to be 70 ohms — much too high if everything was properly connected. I pulled the antenna feed-through insulator apart and sure enough, the flexible wire connecting the two halves was jammed over against the fuselage skin, with a burn mark around it. The accompanying drawing tells the story. I had checked the antenna when it was meant to be shorted and found half an ohm, which was correct. Reassembling the feed-through correctly brought everything back to normal. So what should have been an hour's work took two days!

No, I haven't told the pilots the full story — yet. Perhaps one day I will.

Well, D.J., I don't think you need tell those pilots anything. From my experience of aviators, about any matters other than flying the less they know the happier they be.

Thanks for your stories, and the explanation about the direction finder. The large DF loop antenna that used to feature on top of so many early aircraft has disappeared, and I often wondered what had replaced it. Now I know. Thanks again.

Well, that winds up The Serviceman for this month. I think you'll agree that the stories presented here have related interesting service problems, while at the same time offering informative background material on lesser known items from the electronic menagerie.

I'll be back with more mundane and familiar subjects next month. See you then? ❖

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Cat K-7346

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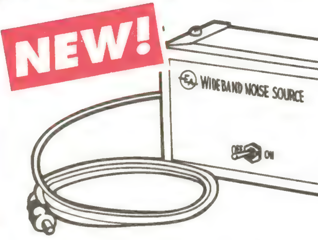
EA May/June/July '94



Wide Band Noise Source

A great accessory for the popular VHF/UHF Spectrum Analyser - now you'll also be able to look at the frequency characteristics of filters, traps, attenuators and more without paying a fortune. Using just a few components on a small PCB, it produces noise over a wide frequency range from a few tens of megahertz up to about 1GHz. It runs on 12V DC at approximately 60mA. Supplied with double-sided PCB, metal case and all components.

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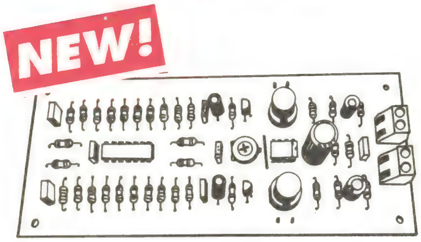

Steam Train Whistle

Add more realism to your model train set! This kit produces all the noises of the traditional steam-generated whistle blown by steam trains. All you have to do for a journey into the past is attach a loudspeaker to your kit. Mounted on a PCB board, it includes 2 switches for different levels of sound and is powered by a 12V DC supply. Comes with PCB and components only.

Cat K-3024

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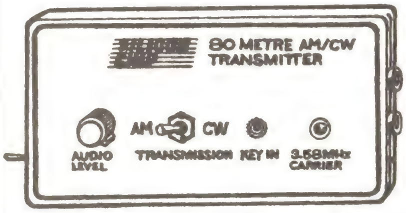
SILICON CHIP July '94



80 metre AM/CW Transmitter

Learn more about radio as you build your own AM/CW transmitter. It's relatively simple and economical to put together and you're sure to get a lot more out of it than from one bought pre-made. Running on just one 6V battery, this low-power transmitter puts out approximately 100mW PEP on the 80 metre band. It can transmit in both Carrier-Wave (CW) for morse code and Amplitude Modulation (AM) formats for audio. Comes complete with all components, hardware, PCB, case and front panel label.

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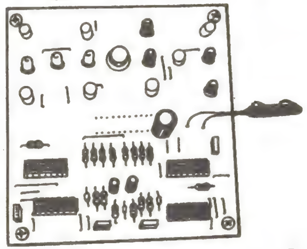
SILICON CHIP June '94



Dual LED Dice

You'll never lose these dice! They have a similar face to regular dice but they're a far more novel idea and you don't even have to bother throwing them. Simply press the button and the electronic dice will "roll" without actually moving. They use just four CMOS ICs, 14 LEDs and a few other components, run from a 9V battery (not included) and will automatically switch off after 30 seconds of use. The kit is in shortform and includes all components, IC sockets, PCB and battery snap.

Cat K-3535

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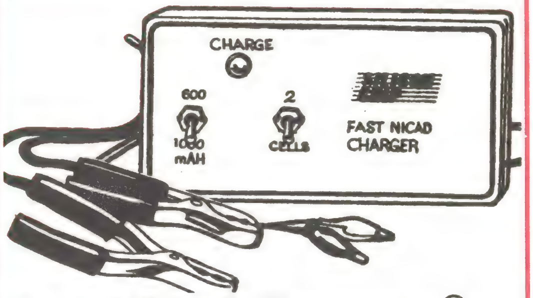
SILICON CHIP June '94



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Cat K-3125

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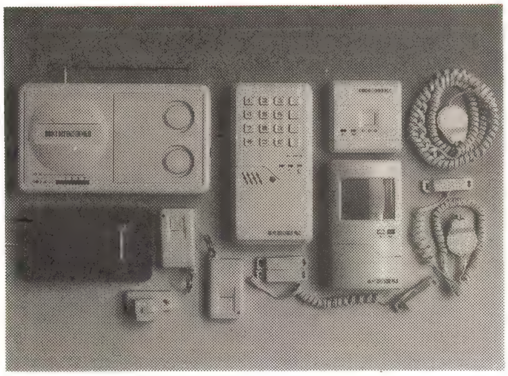
SILICON CHIP May '94

The Most Practical Approach To Home Security



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With no messy wires, this is the ideal home alarm system. It's portable, reusable and offers easy do-it-yourself installation with the inclusion of comprehensive instructions. Advanced features include two remote controls for ease-of-use and user-selectable security codes so you can program in a number that's easy for you to remember. The system consists of a control unit with 110dB in-built siren, door monitor, window monitor (with reed switch and 2 glass break sensors), passive infrared detector, plus an external strobe/siren (110dB) unit. It comes complete with 2 years warranty.
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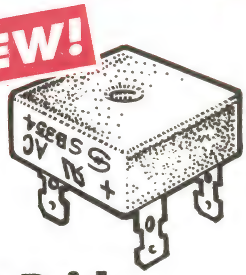

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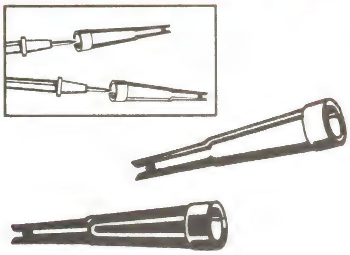

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Resistance:	200 ohm, 2K, 20K, 200K, 2M, 20M.

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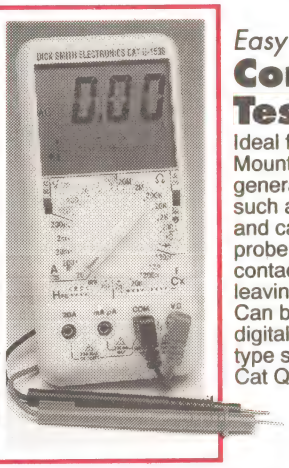

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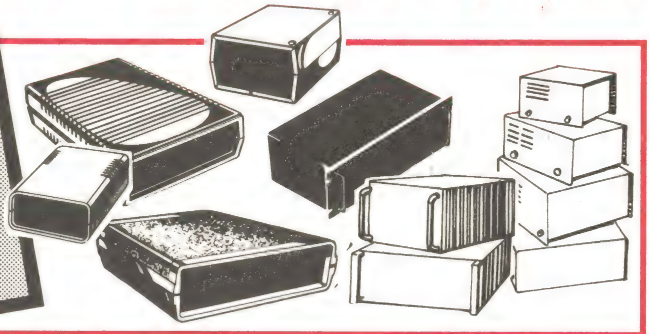

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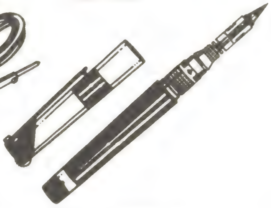

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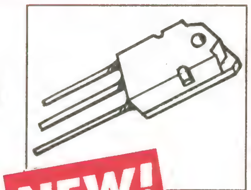

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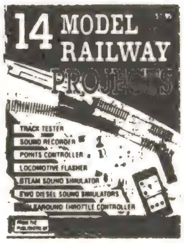
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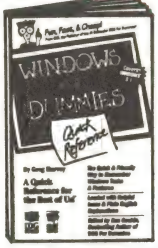
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Quick Reference

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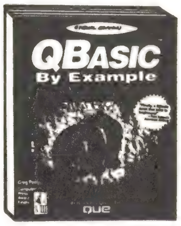
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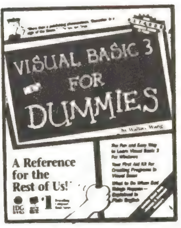
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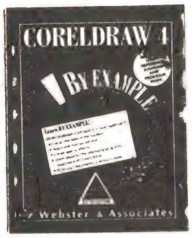
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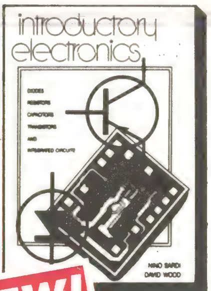
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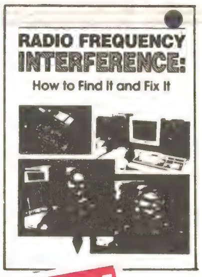
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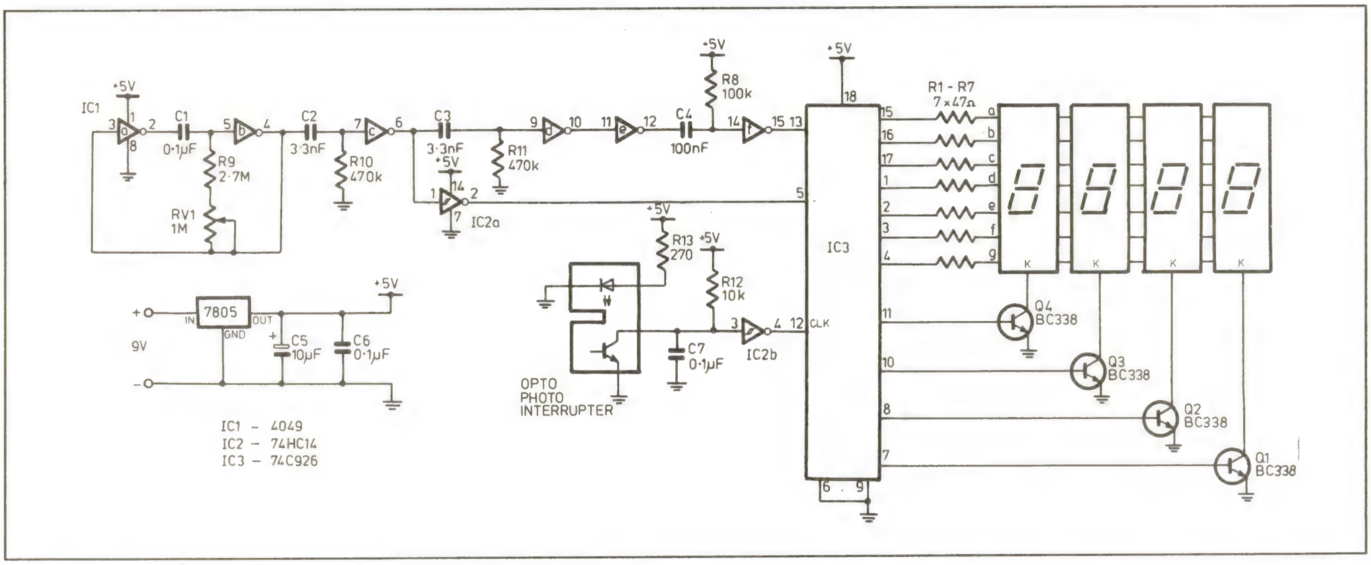
Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.


+5V
IC1
C1 0·1µF
R9 2·7M
RV1 1M
C2 3·3nF
R10 470k
C3 3·3nF
R11 470k
IC2a
+5V
R8 100k
C4 100nF
IC3
18
CLK
R1 - R7 7x47Ω
a b c d e f g
K
Q4 BC338
Q3 BC338
Q2 BC338
Q1 BC338
R13 270
R12 10k
C7 0·1µF
IC2b
OPTO PHOTO INTERRUPTER
7805
IN OUT GND
9V
C5 10µF
C6 0·1µF
IC1 – 4049
IC2 – 74HC14
IC3 – 74C926

RPM meter

This circuit was designed to measure the RPM of a motor shaft, but could be used in any similar application. The photo-interrupter detects 10 pulses per revolution, from a disc with 10 slots fitted to the shaft.

The output of the opto-transistor supplies pulses to the count input (pin 12) of IC3, via Schmitt input inverter IC2b. IC3 is a four-digit counter/driver IC and drives four common cathode displays, multiplexed via transistors Q1 to Q4. The timing circuit formed by IC1a, C1, R9, RV1 and IC1b provides a reset pulse to pin 13 of IC3 and a shorter enabling pulse to pin 5.

The timing of these pulses is determined by the setting of RV1, and the display is updated every 0.2 to 0.9 seconds, giving a versatile display. Calibration is done with RV1. To do this, run the shaft at a known RPM value and adjust the display to the same value.

Steven Tsilomanis,
Reservoir, Vic. **$50**

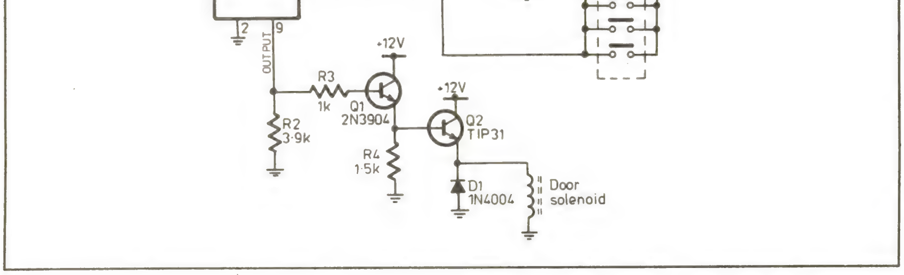
Keyless lock

Most designs for electronic combination locks are complex and expensive. This simple circuit uses one IC, type LS7225, which is designed for this application. The circuit can be run from a 12V gel cell, which also powers the door solenoid, making the system fail-safe if power goes off. When input 1 goes high, the circuit will accept the sequence of inputs 2, 3 and 4, causing the momentary unlock pin 9 to go high. When the 3.3uF capacitor (C2) discharges and input 1 goes low, the other inputs are disabled. I found the four second delay given by C2 adequate, but a larger value capacitor will increase the delay. The solenoid is therefore energised for four seconds. If you input a wrong number, you have to start again, so the lock is quite foolproof.

The commercial door solenoid used in the prototype requires 220mA (at 12V), so the Darlington driver ensures the IC is not overloaded. The solenoid doesn't actually open the door, rather it releases a bolt so you can push the door open.

A data sheet about the IC is available from RS components (no. 4305). They stock the IC as part number 304-554 and they also have a suitable non-matrix keypad (no. 333-704) and door solenoid (626-573). There's also a data sheet on the solenoid, no. 13466. Farnell sell similar parts and also a kit that includes a relay rated at 240V 10A.

D. Jackson,
Mt Hagen, Papua New Guinea. **$40**


+12V
C1 47nF
R1 2·2k
IC1 LS7225
INPUT 4
INPUT 3
INPUT 2
INPUT 1
UNSELECTED
OUTPUT
To any four keys
10 Key Keypad (non-matrix) or 10 n/o pushbuttons
C2 3·3µF
R3 1k
Q1 2N3904
R2 3·9k
R4 1·5k
Q2 TIP31
D1 1N4004
Door solenoid

Closed loop alarm

I was asked to design a 'loop of wire' alarm for a friend who exhibits firearms. He wanted the firearms to be protected by the alarm, yet able to be handled easily.

The alarm therefore needed to be portable (battery powered), have a key switch for arm/disarm, and have adjustable volume. The loop of wire was to have plug-socket connectors every metre or so for easy removal of any weapon.

The circuit has three main blocks: a retriggerable monostable, a multivibrator and a siren driver. The two NAND gates IC1a and b form the retriggerable monostable, with a period of around eight seconds as determined by the values of R2 and C2.

In the armed state, pins 1 and 2 of IC1 are held high, pin 3 is low and C2 is discharged through R2.

When the normally-closed loop is broken, R1 pulls the inputs of IC1a low, and its output goes high. C2 charges quickly through D1, taking the output of IC1b low — which switches on Q1, providing power to IC2.

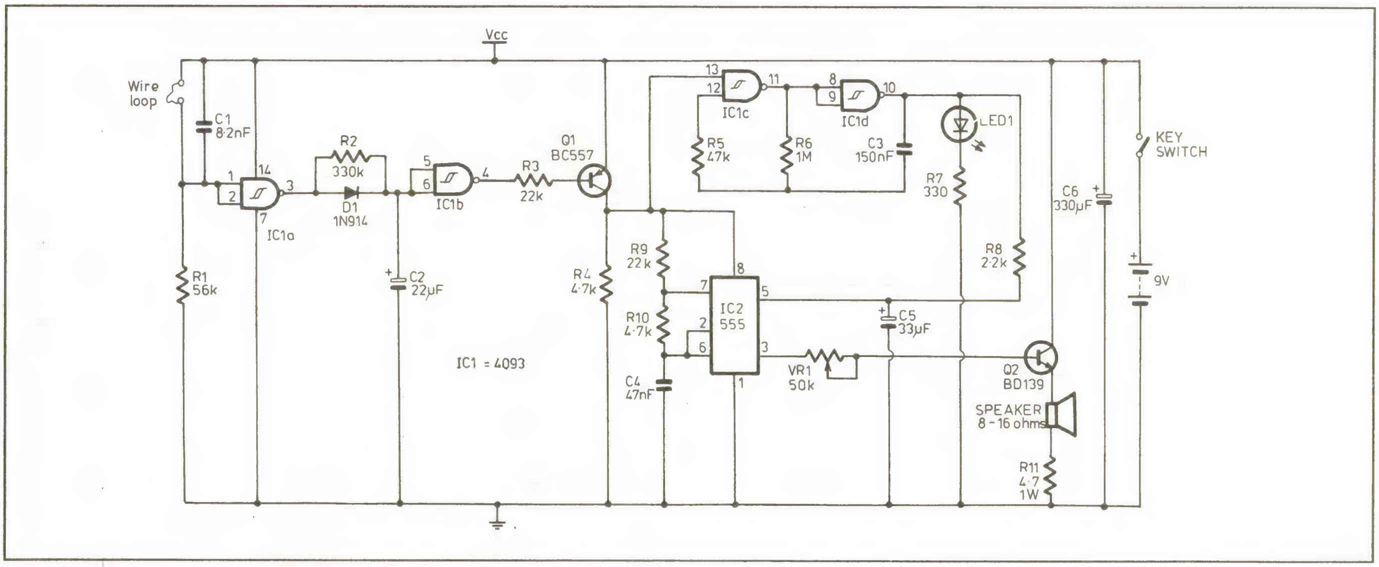
IC1c and IC1d form a multivibrator that oscillates at around 2Hz when Q1 is switched on. The output of the multivibrator is connected to the control voltage input (pin 5) of IC2, causing the siren tone developed by IC2 to warble. A LED is also connected to the multivibrator output to provide a visual indication.

The output of IC2 is connected to the base of Q2, a BD139 power transistor which drives the speaker. VR1 acts as a volume control by controlling the value of the base current to Q2.

The alarm sounds for as long as the normally-closed loop is open. If the loop is closed again, pin 3 of IC1 goes low and C2 discharges through R2. When the capacitor voltage falls below the threshold voltage at the input of IC1b, pin 4 of IC1 goes high, switching off Q1 and stopping the alarm. This way there is a minimum sounding period even if the loop is broken for a very short time.

Because the circuit current is around 170uA until the alarm is activated, the battery life is almost its shelf life. A keyswitch is used to arm and disarm the alarm.

Grant Bourne,
Hamilton, NZ. **$50**



Sensor-light operated door bell

This circuit produces a momentary contact closure when 240V AC is applied. It is connected across the doorbell push button, and powered from a sensor-controlled light.

It therefore gives an audible warning when someone approaches at night, operating the sensor-controlled light. Obviously the light should be immune to false triggering, to avoid this circuit being a nuisance rather than a useful warning device.

Incoming 240V AC derived from the light passes through C1 and is rectified by the bridge D1-D4, giving a 35mA DC current source. Relay A operates, contact A1 removes the short-circuit across relay B, which operates in series with A. Contact B1 now short-circuits relay A, thereby releasing it.

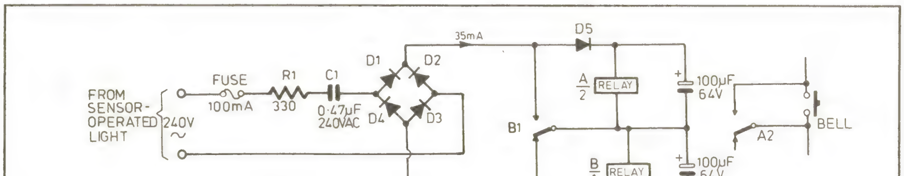
Contact B1 also removes the short-circuit from relay B, which remains operated as long as power is applied. Contact A2 is connected across the bell pushbutton.

The capacitors across the relay coils slow down their operation and release, and diodes D5 and D6 force the capacitors to discharge through the relay coils instead of the contacts.

The nominal coil voltage and resistance of the relays is not important and they don't have to be the same, providing the relays operate reliably with a coil current of 35mA. In fact, the prototype used two relays for A, with their coils in series, as each relay had only one contact.

Capacitor C1 should be 240V AC rated. Resistor R1 limits the surge current and the circuit is protected by a 100mA fuse.

Graham Leadbeater,
Ringwood, Vic. **$45**



If you've developed an interesting circuit or design idea, why not send us the details? As you can see, we pay for those we publish — not a fortune, but surely enough to pay for the effort of drawing out your circuit, jotting down some notes and sending the lot, together with your name and address to Jim Rowe, Electronics Australia, P.O. Box 199, Alexandria 2017.

Construction project:

The IMP - 1

Turn your IBM-compatible PC into a sophisticated audio test instrument, with this Impulse response Measurement and Processing (IMP) system. Costing a fraction of the price of equivalent commercial systems, the described interface module and its matching software will allow you to perform, store and print out acoustic measurements of loudspeaker systems, without the effects of room reflections — plus much more...

by ROB EVANS

Readers with more than a passing interest in the design and use of loudspeaker systems will no doubt appreciate the need for some kind of test setup that can measure the *acoustic* response of an audio system. While your ears can certainly tell you that something might be wrong with the sound, it's often very difficult to determine the source of the problem unless some form of repeatable and objective test is introduced.

Perhaps the simplest method for testing the frequency response of a loudspeaker is to feed the driving amplifier with the output of a sine-wave generator, which is then swept through the audio frequency range while the speaker's output is monitored with a sound level meter (or the combination of a microphone and tape deck). While this method can provide some useful results, the continuous nature of the test signal means that acoustic reflections within a room (mostly from walls, the ceiling, and so on) will add and subtract from the meter readings, leading to an extremely 'lumpy' response curve.

As it happens, this response curve is in fact quite accurate for the perceived sound in *that* particular part of the room while using a sustained signal — since the readings represent the sound from the speaker *plus* the energy contributed by the room reflections. But of course what we are really after is the response curve for the speaker itself, so this simple method doesn't really deliver the goods.

If the above scenario makes you wonder why the sound in a room still seems quite clear to your ears, despite the supposedly ragged frequency response at that point, you really need to consider both the nature of music signals and the way that our brain interprets the information received by our ears.

For a start, most music is composed of essentially transient signals rather than the continuous pure tones used in the above test setup. This means that the original signal from the speaker will have stopped sounding by the time its reflection has returned from the room boundary, and therefore this cannot add or subtract from the original — hence, there are far less troublesome standing waves in music signals.

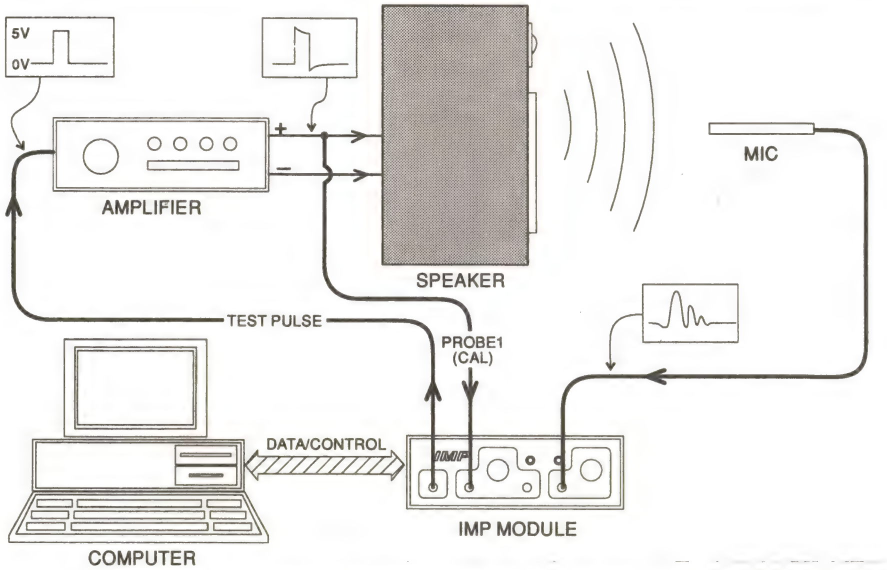
The other point of interest is the way that our brain tends to concentrate on transient sounds from the front, while paying less attention to those that arrive from other directions, and at a later time — in effect, we seem to mentally discard the reflections.

To observe the inverse of this effect, try recording the sound in the room with a microphone and tape deck while you're listening to music. If you then play this back (ideally, via headphones), you will find that the sound is rather confused and indistinct, and you can clearly hear how the room is contributing to the overall sound.

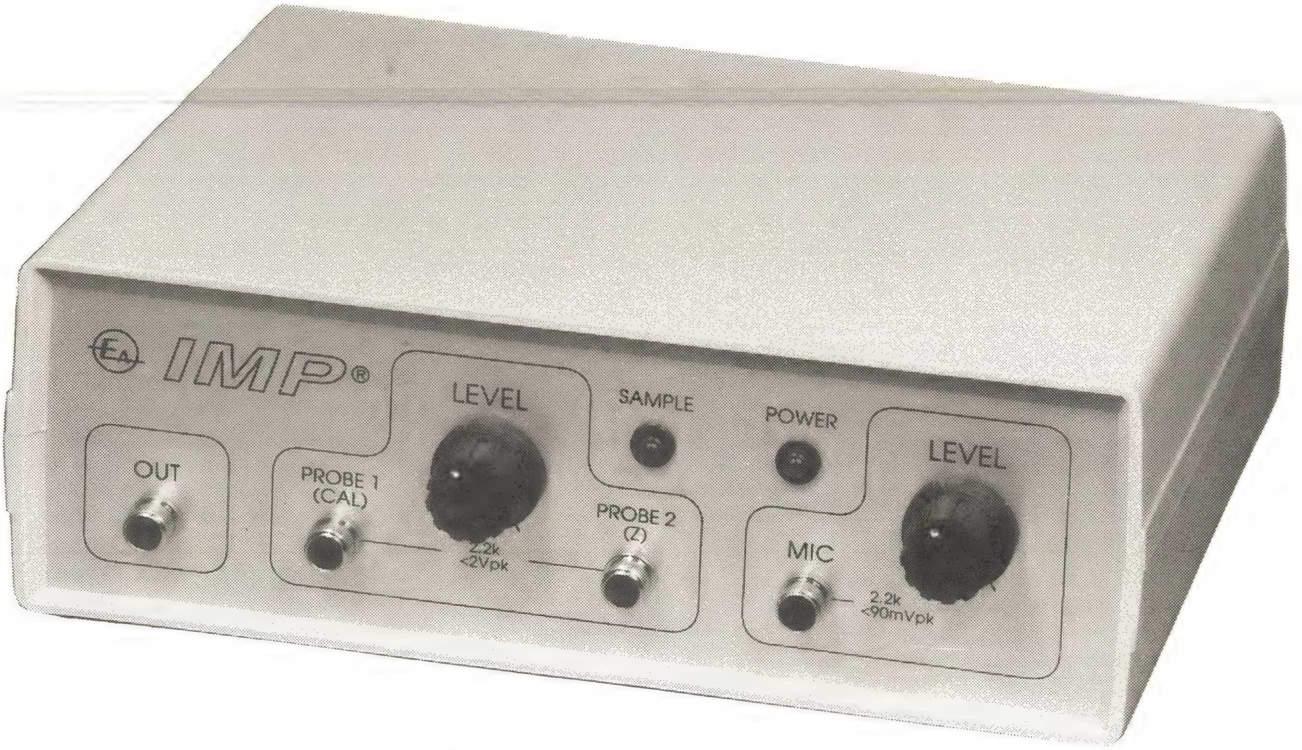
The main difference between the 'live' sound and the recording is that the latter was taken from a single point (the mic position), and your brain has far less information to work with.

One way to eliminate these troublesome reflections from the speaker testing environment is to get rid of the room itself, and perform the tone sweeps in an acoustically 'dead' anechoic chamber. As few of us have access to such a room, and even fewer the funds to build one, we can always make use of nature's own anechoic chamber: the ubiquitous backyard.

The established technique for simple outdoor measurements is to lay the speaker flat on its back (hopefully, you've mowed the lawn), and perform the abovementioned frequency sweep tests with the sound meter (or microphone) suspended above. While this technique can work quite well, it's often rather inconvenient and as you would expect, the readings are easily corrupted by



The IMP setup. The IMP module sends a known test pulse to the speaker via an amplifier, then 'records' the result pick up by a high quality microphone — all under control of the PC.



ambient noise — and there's plenty of that outdoors...

This of course brings us to the more expensive and elaborate range of solutions to the speaker testing problem: dedicated instruments. These can be chart-style recorders, computer-driven cards or modules, or self-contained digital recorders/processors.

All of the above instruments vary widely in price (hundreds to thousands of dollars), and use different methods to reduce or eliminate the effects of reflections and standing waves. For example, the simpler chart recorders use a frequency modulated test tone (warble) to inhibit the build-up of standing waves, while the micro-controlled instruments tend to use far more elaborate gating and post-processing techniques.

An impressive example of the computer-based solution is LMS (Loudspeaker Measurement System) from Audio Technology Incorporated, which was reviewed in the June 1992 issue of *Electronics Australia*. Supplied as a plug-in card for your PC, this system uses bursts of sinewaves as the test signal, and gates the returned microphone signal in a synchronous manner — the tone bursts avoid standing waves, while the mic gating shuts out transient reflections.

Thanks to the PC-based platform, test instruments such as LMS have the ability to store and recall test data, produce high-quality hardcopy via a laser printer, perform automated test and setup routines, display the results of more than one test run at a time, and perform a whole range of valuable post-processing tasks. If you can afford it, the computer/micro-based solution is the way to go...

Another PC-driven audio test setup of particular interest is DRA Laboratories' MLSSA (pronounced 'Melissa') — an acronym for Maximum Length System Analyser. Unlike LMS, this system uses a single burst of special pseudo-random noise as a test signal, and using the usual test microphone, simply records the version produced by the speaker. Then by using the computer's processing power, MLSSA can convert this time-domain data into a wide variety of formats including a conventional frequency response plot (that is, in the frequency domain).

Since the basic data is in the form of amplitude versus time however, MLSSA can choose to process just the initial portion of the signal where the energy from room boundary reflections has not yet arrived at the microphone. In other words, by picking the correct section of the returned pulse data, you can produce an 'anechoic' response curve for the speaker under test.

This, coupled with the fact that this single pulse type of testing bears almost instant results (no more slow audio frequency sweeps), makes MLSSA a very effective speaker testing system. Including very sophisticated software, it's clearly aimed at professional applications and as you might expect, carries a corresponding 'professional' price tag...

The good news is that thanks to the new build-it-yourself IMP system, the convenience and power of these computer-based instruments now available at a price within the reach of hobbyists and home 'tinkerers'. And of course, this also makes it a bargain for professionals in the loudspeaker design field.

The birth of IMP

First, some background on the project. Both the IMP hardware and software was developed by talented US-based engineer Bill Waslo of Liberty Instruments in Middletown, Ohio. The completed system was then published as a project in the specialist *Speaker Builder* magazine (again in the US) in several issues through 1993, with kit parts made available though both Liberty Instruments and Old Colony Sound Laboratory — the latter being a subsidiary of Audio Amateur Publications, the publisher of *Speaker Builder*.

We first became aware of the IMP system through the irrepressible Peter Stein of ME Technologies, who is the Australian agent for Old Colony Sound and as it happens, also handles the LMS system mentioned above. Peter sent us copies of the original *Speaker Builder* articles, to see if we were interested in producing our own version of the IMP system, for publication in *Electronics Australia*.

Needless to say, when we saw how powerful and flexible the IMP system was, we jumped at the chance. To cut a long story short, Peter then completed negotiations with those involved with the IMP system in the US, and we were granted permission to reproduce the IMP system in Australia. The end result is that we have designed a new PCB, made minor improvements to the circuit, and generated artwork for a low cost instrument case to house the IMP board. And of course, we've fully tested the system in our lab, and produced our own series of articles for *EA*.

We're also happy to report that ME Technologies has secured the rights to supply key IMP items such as the all-important software and the matching high quality test microphone — but more of this later.

IMP principles

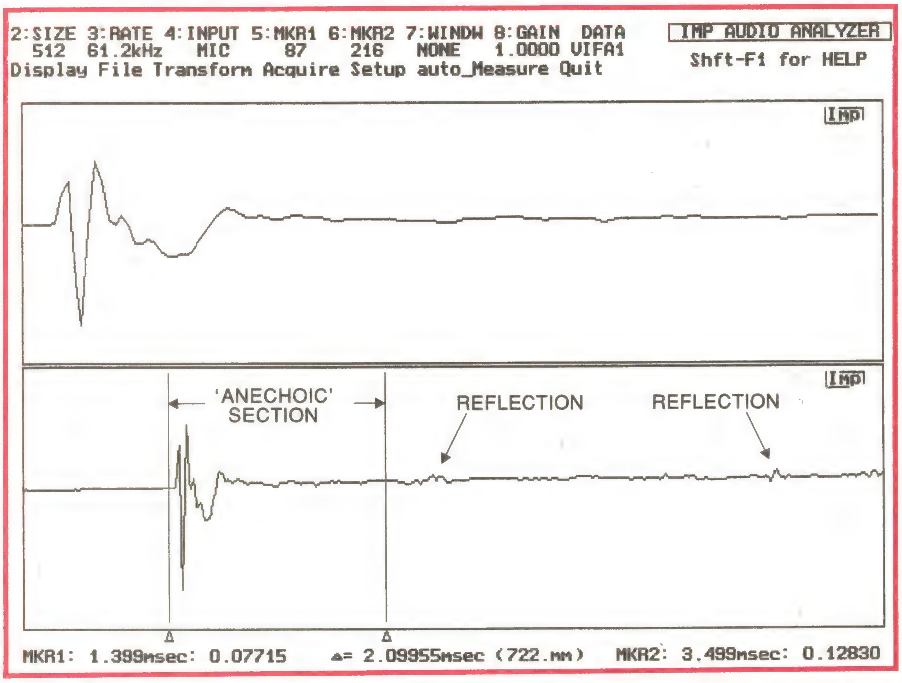
In simple terms, IMP's process is based on the fact that if a system (loudspeaker, amplifier, or whatever) can accurately reproduce a narrow pulse (with 'instant' rise and fall times), then it has a linear frequency response and exhibits no phase delays. On the other hand, the way in which a system corrupts this pulse will indicate how its frequency response and phase margin differs from the ideal.

The real trick however, is in converting the information contained in the reproduced pulse, which is in the *time* domain (amplitude versus time), into data in the *frequency* domain, so we can produce a frequency response plot.

Since a mathematical analysis is beyond the scope of this article, it's probably sufficient to say that this conversion can be performed by a Fourier Transform. In the case of the IMP system this operation takes place in the host PC as a Fast Fourier Transform (FFT), since this variation of the Fourier Transform is quite suitable for computer calculations.

To perform a test, the IMP module itself generates the narrow pulse, which is then applied to (say) a loudspeaker via an associated amplifier. Using a test microphone, the module then records the resulting signal from the speaker in a digital form, and passes this to the PC where it's converted to a response plot — the arrangement is shown in Fig.1.

As well as the microphone and test pulse lines, note that Fig.1 also shows a connection labeled 'probe 1 (cal)'. This samples the speaker's drive signal (in effect, the actual test pulse), so that the IMP system can allow for the fact that even this signal will never be an 'ideal' pulse. The waveshape shown in the diagram, for example, implies that the amp is rolling off the lower audio frequencies — a likely scenario. You may also notice from the shots of the prototype that the module includes a second probe input, in this case labeled 'probe 2 (z)'. This allows the IMP system to directly measure a system's electrical response, as opposed to an acoustic response via a microphone and the 'mic' input. Thanks to this second probe input the IMP system can be configured to quickly measure the response of crossover networks, equalisers, active filter stages, preamps, and just about any other audio circuit that operates at a 'line-level'.



```
2:SIZE 3:RATE 4:INPUT 5:MKR1 6:MKR2 7:WINDW 8:GAIN  DATA
  512  61.2kHz   MIC      87    216    NONE   1.0000 VIFA1
```

```
MKR1: 1.399msec: 0.07715     ▲= 2.09955msec (722.mm)    MKR2: 3.499msec: 0.12830
```

Fig.2: A speaker's impulse response recorded by IMP, with the reflections produced by the room boundaries marked. The 'anechoic' part of the signal has been expanded into the upper trace.

Fig.2 shows a screen image captured from the IMP software, and includes additional labelling to highlight points of interest. Here, the lower section shows the first 8ms or so of a typical signal returned from a loudspeaker when driven by IMP's test pulse. Despite the fact that the waveshape bears little resemblance to the original clean square test signal, IMP can extract a wealth of information about both the speaker and its surrounding environment from this single trace.

As you can see, the two markers show the 'anechoic' section of the waveform, and the room's major reflections appear to the right of this area — that is, later in time. The time delay between the left-hand end of the trace and the start of the returned pulse represents the distance between the mic and the speaker, and the minor amplitude variations in the trace show the effects of ambient noise and smaller, more diffuse reflections. Note that the 2ms or so long anechoic portion of the lower trace has been expanded into the upper trace, ready for further processing by IMP.

The software then performs a FFT on this isolated section of data, and generates both a frequency response curve and its matching phase information, as shown in the lower and upper traces of Fig.3, respectively. Note that this particular speaker suffers from a deep hole in its frequency response between 4kHz and 7kHz, due to driver interaction around the crossover region.

IMP can also perform multiple, time-shifted FFT conversions on the original time-domain data, which generates the rather spectacular looking 'waterfall' plots as shown in Fig.4. These are also known under the rather more lofty title of 'cumulative spectral decay' plots.

In this mode, IMP first completes a normal FFT on the recorded trace, then performs another at a slightly later starting point (later time), and repeats this process while introducing an ever-increasing time delay. In short, it shows how the speaker's frequency response changes with time.

The actual waterfall display is built up in a three dimensional fashion by drawing each frequency response plot in a slightly shifted position on the screen, thereby giving the illusion of depth. In the example shown, the plot shows the delay characteristics of a tweeter with a metallised diaphragm, which has a very strong resonance in the 9kHz region — you can see this frequency 'hanging on' as time progresses. The ideal waterfall plot would show that a speaker exhibits a flat frequency response at time zero, and then delivers little or no energy at subsequent (delayed) response plots.

IMP's ability to perform direct electrical testing also means that by using both probe inputs, a reference resistor, and an appropriate software routine, the system can quickly plot the impedance curve of a loudspeaker. In this case, the probes are connected on either of the resistor, which has been inserted in series with the speaker drive signal, and the program computes (through FFT) the impedance by noting how the voltage drop varies with frequency. For example, if half of the source voltage is reaching the speaker, its resistance at that time (ultimately, for that frequency) must equal that of the test resistor.

By using this same technique and an additional software feature, IMP can also calculate a driver's electrical and mechanical parameters from two impedance plots — one for the driver in free-air, and the other for the driver when an additional mass (say modelling clay) is attached to the cone. Popularly known as Thiele/Small parameters, this valuable data is mainly used to predict how the driver will behave in a given enclosure, through the use of manual or computer-based modelling techniques — and there's no shortage of low cost software available for this job.

The software

IMP's software is really quite sophisticated, and in many ways rivals that of far more expensive commercial speaker testing systems. Designed to run on IBM-compatible PCs with a very modest minimum configuration, it runs in the normal DOS environment (that is, not under *Windows*) and is currently supplied on just one floppy disk in an uncompressed form.

You can even run the program directly from the floppy, which makes IMP quite suitable for older PCs that don't have a hard disk.

More specifically though, the PC's minimum requirements are 640K of memory, DOS 3.1 or higher, a parallel port, and a 'high resolution' display (all popular types *except* CGA). The software itself makes extensive use of colour (although mono screens are fine), and can be controlled by a mouse or keyboard.

We found that the IMP program worked quite well on our old monochrome XT-type machine in the *EA* lab, where its very modest performance slightly slowed the data retrieval rate through the parallel port, and made FFT and curve drawing operations sluggish. While it's certainly practical to use such a machine, you need to be patient when waiting for the results of more complex operations such as waterfall plots. Conversely, the program fairly rockets along on a '368 or '486-based machine.

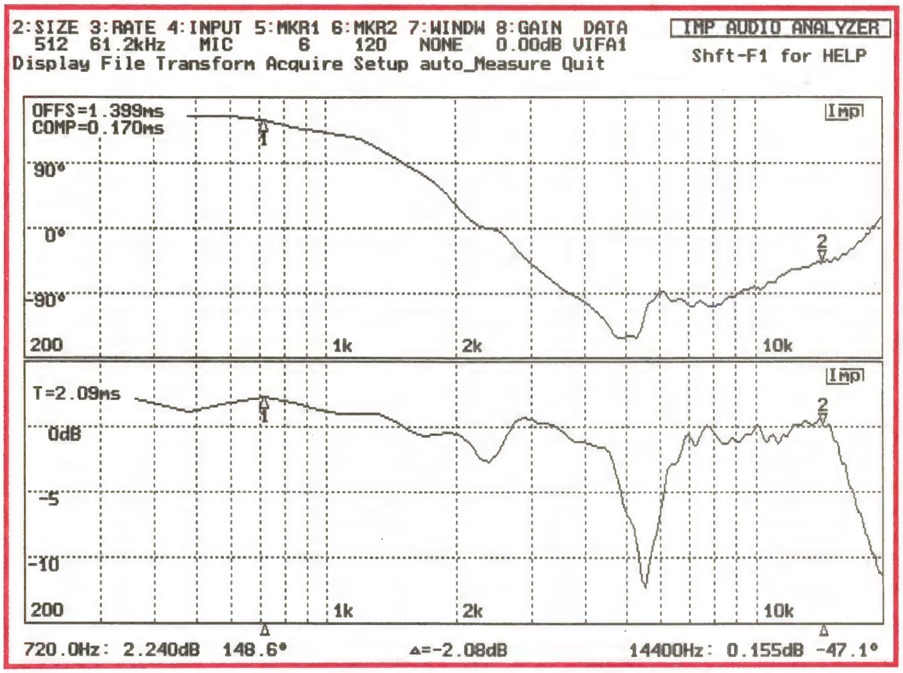
The major features of the software are as follows:

- Averaging of multiple sample runs to reduce the effect of ambient noise.
- Displays up to five different response plots on one screen, for comparison purposes.
- Adjustable scales (frequency, amplitude, impedance, etc.,) and smoothing (one to one-twelfth octave) on all curves, plus variable signal 'gain'.
- Prints curves and traces to both laser and dot matrix printers.
- Has a context-sensitive on-line help system.
- Saves data files to disk in a variety of forms — impulse trace, frequency response, impedance plot, and so on.
- Common testing routines (acoustic, electric, impedance, etc.,) are available as single key macros — IMP's 'AutoMeasure' menu.
- User defined macros and program preferences, which can be saved to disk.
- Has the ability to cut, paste and merge different response plots into one, for joining low frequency (near-field) and high frequency curves.
- Any task can be cycled on a continuous basis — for 'real-time' testing.
- Maths co-processor version also available, for faster operation on suitably equipped machines.
- Distance measurement, speaker parameter calculation and phase computation software routines.
- Movable cursor marks for 'spot' measurements on curve data, and for defining sections for FFT operations.
- Ability to automatically apply a microphone calibration file, to compensate for measured mic inadequacies.

As you can see the IMP system is packed with features, and should be able to perform just about any audio-related measurement you're likely to need. It has an extremely wide range of applications in both the amateur and professional fields, from speaker positioning and level balancing in your home through to fully blown commercial loudspeaker design — it's only limited by your imagination.

One very significant asset of the IMP system that we haven't yet mentioned is its potential as a *fully portable* acoustic test setup, when coupled to a laptop computer. This is not really possible on most other computer-based systems, since their hardware tends to be contained on a circuit board (or 'card') that is designed to fit into a PC's internal expansion slot. Since this card is usually of the large full-length type, it just won't fit into the majority of laptops (even if it *has* an expansion slot), leaving your test setup desk-bound in a conventional PC...

With IMP on the other hand, its free-standing hardware communicates with the computer via the standard parallel port, and all that's really needed is a machine equipped with both a suitable port and a high resolution display (not CGA). This in turn means that just about any current laptop, notebook and even



```
2:SIZE 3:RATE 4:INPUT 5:MKR1 6:MKR2 7:WINDW 8:GAIN  DATA      IMP AUDIO ANALYZER
 512   61.2kHz  MIC      6    120   NONE   0.00dB VIFA1
Display File Transform Acquire Setup auto_Measure Quit          Shft-F1 for HELP
```

```
720.0Hz: 2.240dB  148.6°          Δ=-2.08dB          14400Hz: 0.155dB -47.1°
```

Fig.3: The result when a Fast Fourier Transform (FFT) is applied to the signal shown in Fig.2. The original time-domain data has been converted into a matching frequency and phase response plot.

sub-notebook will do the job, plus any of the older laptops equipped with EGA/VGA displays.

Also note that the machine does not necessarily need a hard disk, and the IMP module itself could be powered by a standard 9V battery, as its current consumption is quite low.

An added bonus of IMP's independent hardware scheme is that the entire testing system can be easily and quickly transferred to another computer, since there's no need to remove and re-fit a hardware card, or for that matter, perform a protracted software installation on the current machine. It's simply a matter of connecting the module to the printer port and popping the software disk into a floppy drive — IMP is inherently a portable system.

Your own IMP

By now, you're probably champing at the bit to get hold of an IMP system for an application that's already sprung to mind. As mentioned above, ME Technologies can supply the essential items such as the IMP software in its most current version (it's being improved on a regular basis), and the matching high quality test microphone.

The mic is based on a very small electret capsule manufactured to tight specifications by Panasonic. This is normally installed at the end of a long brass or aluminium tube, and is reported to have a flat response within +/-2dB at frequencies up to 20kHz. By the time you read this, ME should be able to supply the complete mic with or without an associated IMP calibration file, or just the capsule itself. And by the way, as a test mic it's quite suitable for other applications.

There are several choices for securing the hardware part of the system, the IMP module. The most time consuming method is to build the module from scratch, as was the case with our prototype unit, by constructing your own PCB and chasing up any uncommon parts. However, note that the board is a double-sided type, and the circuit's A/D converter chip is not a normal off-the-shelf component.

The second and more practical scheme is to purchase the double-sided PCB and the A/D converter chip from ME Technologies, who plan to offer a basic 'essential parts' kit which will include all of IMP's special items. In this way, you can use components from your own stocks, including a suitable instrument case that may be at hand. However, the path that should provide the least frustration is to purchase a full kit of parts from ME Technologies, in the normal manner. By using the construction guide presented in these articles, you should have little trouble in assembling the IMP module and getting the system up and running.

ME also plan to offer fully built, tested and guaranteed IMP modules, which should suit those who don't have the time or perhaps patience to build their own. In any of the above cases though, we would recommend that you contact ME Technologies for more details regarding the range of options.

At the time of writing, the pricing structure for the IMP software, range of hardware kits and its test microphone had not been finalised, thanks to varying exchange rates and shipping delays. In very rough 'ballpark' figures though, we can say that the IMP software will be available for around $90, the double-sided plated-through PCB for about $30, and the microphone assembly for approximately $50 (its capsule should be priced at around $10).

For more accurate pricing and details, check ME Technologies' advertisement in this copy of *EA*.

Applications

While those interested in building an IMP system will probably have a particular use in mind, it's worth mentioning some of the amateur and professional applications that would benefit from this low cost test setup. As noted earlier, its uses are only really limited by your imagination...

- Home hifi: Optimising speaker positions within the listening room. Setting equalisers and driver level controls. Analysing and modifying room acoustics.
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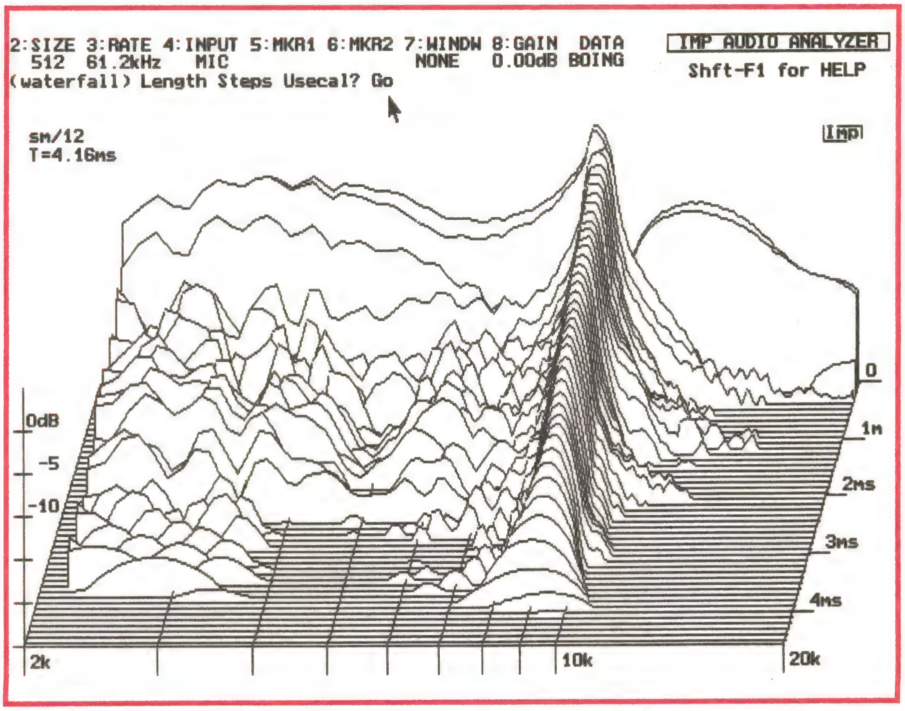
- Sound recording studio: Monitor speaker equalisation, 'bass trap' tuning, room and sound booth acoustic testing.
- Speaker manufacture QC: Quality control testing of loudspeakers (using IMP's macro, cycling and curve comparison features).
- Impressing your friends: The waterfall plots in particular look terrific...

That about covers our overview of the new IMP system. In our next instalment, we'll present the full schematic diagram for the module and discuss the circuit's operation. ❖



```
2:SIZE 3:RATE 4:INPUT 5:MKR1 6:MKR2 7:WINDW 8:GAIN  DATA
 512   61.2kHz  MIC                 NONE   0.00dB BOING
(waterfall) Length Steps Usecal? Go
```

Fig.4: A 'cumulative spectral decay' (waterfall) plot of a tweeter fitted with a metallised diaphragm. Note the extended resonance at around 9kHz.

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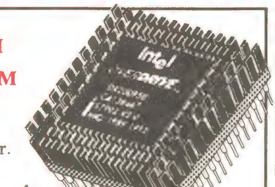

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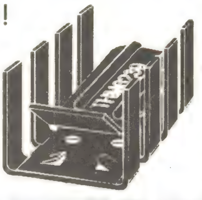

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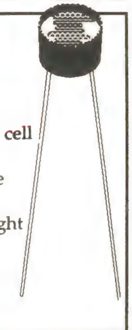

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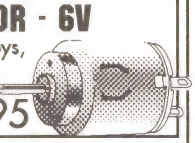

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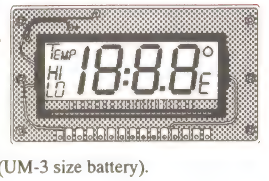

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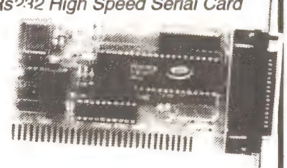

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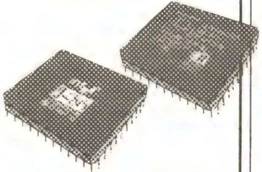

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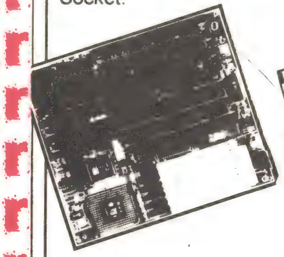

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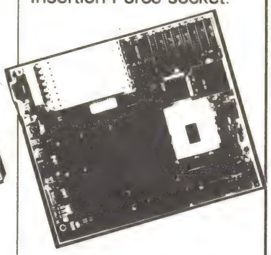

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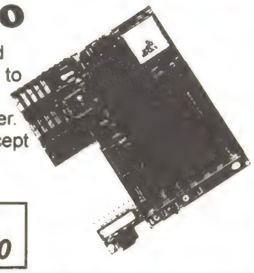

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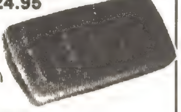

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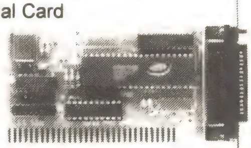

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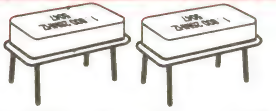

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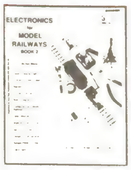

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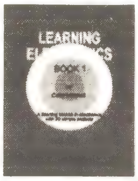

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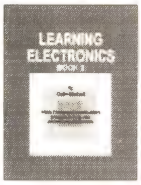

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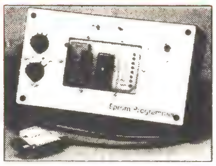

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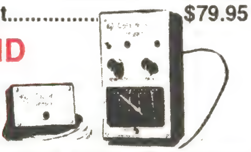


Always wanted to create special effects with your camera by capturing that exact moment when something occurs? For example, a light bulb breaking, a drop of water splashing into a puddle or bowl or a tennis or squash ball impacting with a wall or racquet! Well with this light and sound trigger you can . This kit activates the camera flash from a sound source. You can also trigger a second flash from the main one or even delay the flash by a controlled time.

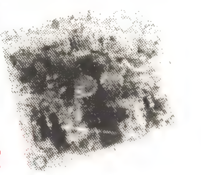
The kit includes the following: 2 PC boards, 2 boxes, audio transformer, solar panel, mic insert, 3.5 socket and all specified components.

Extension sync lead flash is not supplied. These are available from most camera stores.

REF. ELECTRONICS AUSTRALIA APRIL '94

K10535 $41.95

LOW-NOISE UNIVERSAL STEREO PREAMPLIFIER

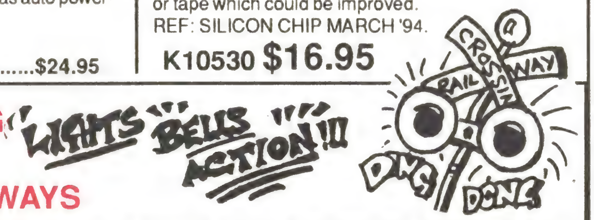


This universal preamplifier can be easily constructed for use with a magnetic cartridge, cassette deck or a dynamic microphone. It uses a single dual op amp IC & has very low distortion. This preamp uses the industry standard LM 833 dual op amp IC which has very low noise and distortion. Perhaps the prime use will be for those people who have an integrated stereo amplifier which they are keen on but which has a phono or tape which could be improved.

REF: SILICON CHIP MARCH '94.

K10530 $16.95

LEVEL CROSSING DETECTOR FOR MODEL RAILWAYS



Add realism to your model train layout with this level crossing circuitry. It will detect the approach of a train, monitor its passing, provide an output to control circuitry to flash lights and sound a synthesised bell. The circuit is designed to detect the train as it approaches the crossing and start the lights and sound module. When the train has passed through the crossing, the lights and module turn off.

Silicon Chip MARCH '94 **K10510.............................$22.95**

SOUND & LIGHTS FOR LEVEL CROSSINGS

It's probably every model railway enthusiasts ultimate aim to make their railway as realistic as possible. This kit, which is intended to be controlled by the level crossing detector published in March '94 "Silicon Chip", drives LEDs or miniature incandescent lamps for level crossing signs and produces an most convincing bell sound as an accompaniment.

Apart from the lifelike effect of the flashing lights, the particular attraction of this project is the uncanny sound of the bell. If you've ever stopped at a level crossing on a rainy or foggy night you may recall the eerie sound of the bells as their rate of ringing wavers up and down. This circuit reproduces this effect and thereby greatly adds to the realism. REF. SILICON CHIP APRIL 1994.

K10515...............$37.95

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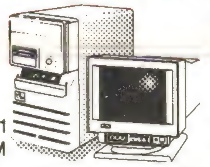

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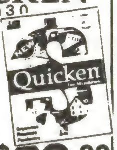

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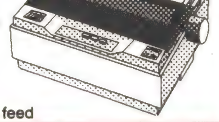

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Mini Construction Project:

THE SOLDER FUME BUSTER

Are you concerned about those reports on the health risks associated with soldering fumes? If you are, this project has been designed for you. It's a low cost fan, with an electronic speed control, designed so that it gently discourages those fumes from following their natural tendency — which is to seek out and enter your nostrils.

BREEZE
TORNADO
EA
The SOLDER FUME BUSTER

Just as the smoke from a barbeque fire always seems to blow in your face, regardless of which side you stand, so the fumes from soldering always seem to be attracted to your nostrils. It seems to be another corollary of Murphy's Law...

For many people working in electronics, this has traditionally been little more than a minor irritation. However some people are reported to experience a severe allergic reaction, and the fumes are now coming under suspicion as a possible triggering agent for occupational asthma.

In the Forum column of our March 1994 issue, we reprinted a story from *IEE News*, published by the Institution of Electronics Engineers in the UK, discussing the health risks now believed to be associated with soldering fumes.

One approach to reducing these risks is to wear a respirator or 'gas mask', with a filter to remove the fume particles and vapours.

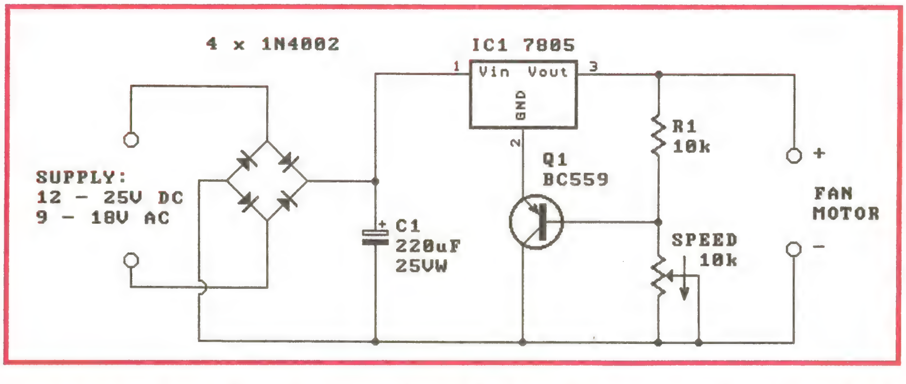
However like the recommendation that we all wear safety goggles while soldering, this does seem a bit like overkill.

Happily a low-hassle method of discouraging the solder fumes from seeking out your nostrils has been developed by reader Bob Parker, who in real life is a busy service technician.

A couple of years ago Bob found that a small fan, blowing gently across the workbench, did the trick — the fumes are wafted away from your face, and allowed to disperse where they generally do little harm (providing your work area is reasonably well ventilated).

The fan doesn't need to be running at full bore, where both its air blast and noise would be irritating; a gentle breeze is quite sufficient, although it does work

This rear view shows the muffin fan visible behind its cutout, and the connector for the raw DC input.



Bob Parker's simple speed controller circuit uses a bridge rectifier to allow powering from either an AC or DC plug pack, together with a three terminal regulator chip and transistor combination to vary the fan motor's voltage.

better if it's spread out a bit in the horizontal plane...

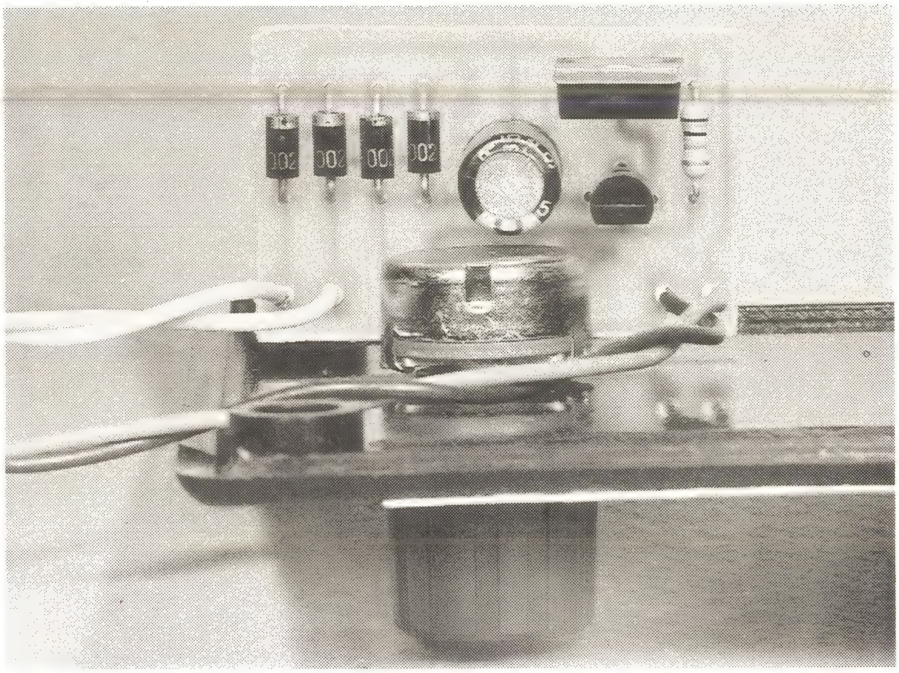
When Bob discovered this neat trick, he made up a small fan with a simple speed control — his first 'Fume Buster'. It was crude, but effective. In fact it worked so well that some of his friends wanted him to build copies for them, and finally he found himself having to design a small PCB to make building the speed controls easier.

When he approached Bob Barnes of RCS Radio, to have a few boards made, Bob B not only helped him 'tidy up' the PCB pattern and make some boards, but also suggested that he send *EA* the details, so other readers could benefit from his discovery.

So that's the background to this little project; a few hours work resulted in a tidied up prototype unit for us to photograph, and the Fume Buster was ready for this public debut.

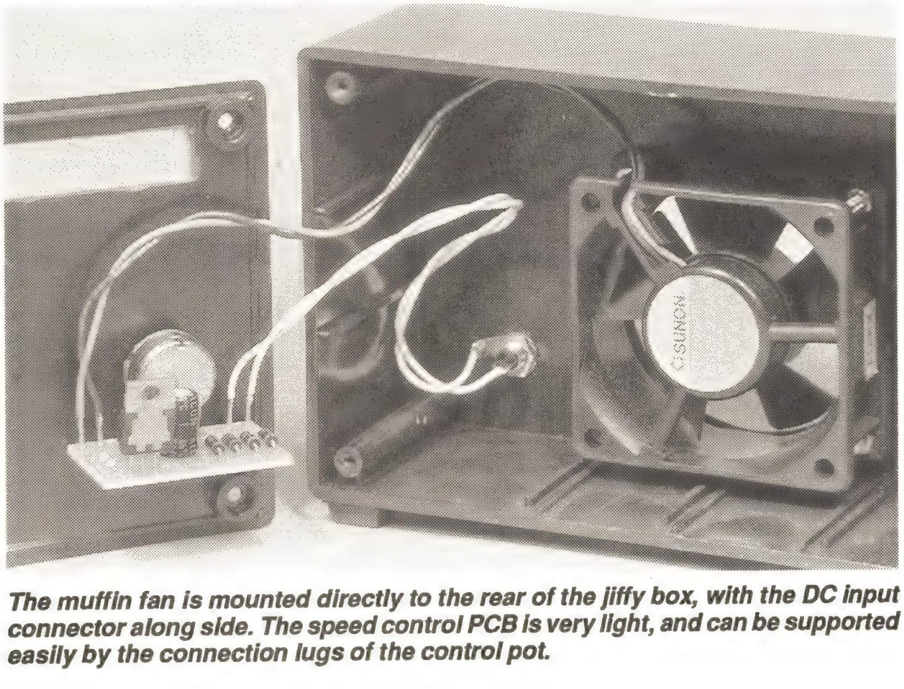
As you can see, it's very straightforward. A small low cost 12V DC 'muffin' fan of the type used to cool computers and other equipment is mounted in the rear of a standard UB-1 size jiffy/zippy box, which has a 120 x 10mm slot cut in the top of the lid to act as an air outlet and 'spreader'. The fan is powered from a standard plug-pack power supply, via Bob Parker's little speed control circuit — which uses only a handful of parts, mounted on a tiny PCB supported by the control pot.

That's all there is; the speed control allows you to set the fan speed for the most convenient level of air flow, from very low indeed ('breeze') to a level which is still less intrusive than the blast from a small personal cooling fan (despite the tongue-in-cheek label 'tornado').


This close up view of the speed control pot and PCB should make it easy to construct. As you can see, only a handful of parts are required.

The circuit

The schematic shows the simplicity of Bob Parker's speed control. An input bridge of four 1N4002 or similar 1A diodes allows you to use either an AC or DC output plug pack to power the Fume Buster, and also makes polarity unimportant. You can connect up virtually any DC plug pack with an output between 12V and 25V, or any AC plug pack with an output between 9V and 18V, with either connection polarity.


The muffin fan is mounted directly to the rear of the jiffy box, with the DC input connector along side. The speed control PCB is very light, and can be supported easily by the connection lugs of the control pot.

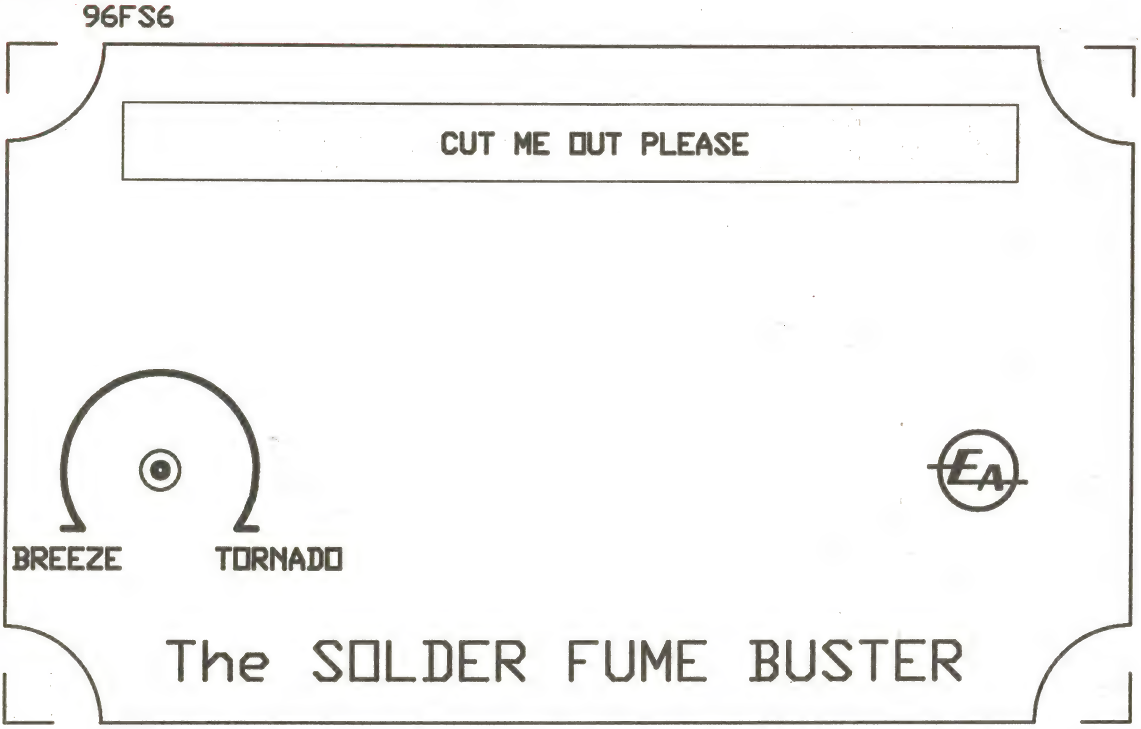
Following the bridge is capacitor C1, used as a reservoir when an AC source is being used, to ensure that the fan motor operates quietly. Then there's the actual speed control circuit itself, which uses 5V regulator chip IC1, transistor Q1, resistor R1 and the 10k control pot.

As you can see, the circuit is essentially an adjustable voltage power supply, which simply varies the voltage fed to the fan motor. It does this by using transistor Q1 as an 'upside down emitter follower', to vary the voltage level at the common or 'Gnd' terminal of the regulator IC.

To visualise how the circuit works, remember that the IC always acts to produce a fixed 5V DC between its output pin and the common pin. Since the transistor has a relatively fixed voltage of 0.6V between its base and emitter when its conducting (as it is here), this also means that the circuit tends to maintain a fixed voltage of 5.6V (5V plus 0.6V) across resistor R1, connected between the positive output and the transistor's base.

Now consider what happens when the pot is turned fully anticlockwise. Here the base of Q1 is effectively shorted to the negative rail, with no voltage drop between the base and collector. As a result, the total output voltage fed to the fan motor is simply the 5.6V developed across R1. On the other hand, when the pot is turned fully clockwise its resistance increases to 10k, effectively connecting the base of the transistor to the centre of a 10k+10k voltage divider,

The Solder Fume Buster



If you wish to make your own front panel for the fume buster, use a copy of this actual size artwork. A copy can also be used as a template for the holes in the panel.

across the fan motor. Since the voltage across R1 will still be held at 5.6V, the divider current and the action of Q1 will establish another 5.6V across the pot, so the total output voltage will become approximately 11.2V — or near enough to 12V.

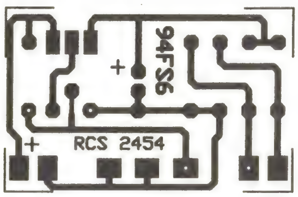
So the pot allows smooth control of the voltage fed to the fan motor, from a minimum of 5.6V to a maximum of over 11V. As the regulator IC handles virtually all of the motor current, transistor Q1 and the pot need only be rated for low power. In fact Q1 can be a BC559 or almost any similar low power PNP device, and the pot is a standard linear carbon type.

Construction

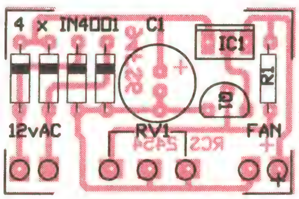
The components for the speed control are all mounted on a PCB measuring only 38 x 24mm, and coded 94fs6. This is actually supported by the lugs of the control pot, as you can see from the photos. Fitting the components to the PCB should also be easy if you use the photos and the overlay diagram as a guide.

The pattern for the PCB is also reproduced here actual size, for those who want to make their own. Note that the positive electrode of electrolytic cap C1 faces towards the back of the board (i.e., away from the pot), as does the metal tab side of the regulator chip IC1.

The muffin fan mounts inside the back of the jiffy box, as you can see, with a round clearance hole to allow maximum air flow. Four 3mm holes are drilled with equal spacing around the periphery, for the mounting screws. It's easy to do this if you use the fan itself as a template, to mark the hole positions.



As usual, here is an actual size reproduction of the PCB artwork, for those who like to etch their own boards.



And finally, the overlay diagram to clarify exactly where everything goes on the board. The three connection pins in the centre of the lower edge of the board connect to pot, with those at each end connecting to the power input and fan motor respectively.

The only other hole in the case itself is for the raw input from the plug pack; Bob Parker used a single hole RCA-type socket, as you can see, but the exact choice is yours.

On the lid of the box, you have to drill and ream a mounting hole for the speed control pot, and also the long slot at the top for the air vent. The two Bobs have provided an artwork for the Fume Buster's front panel, which is reproduced here actual size so that you can use copies both as a drilling template, and also as a front panel if you wish.

Not surprisingly Bob Barnes is making both PC boards and Dynamark front panels for the Fume Buster, so you'll be able to save yourself some hassle and end up with a neat job by getting them from him at RCS Radio, 651 Forest Road, Bexley 2207; phone (02) 587 3491.

Small 12V muffin fans suitable for the Fume Buster are also currently available from Altronics, Dick Smith Electronics, Jaycar and Geoff Wood Electronics. But shop around, because the prices vary over quite a wide range.

So build yourself a Fume Buster, and experience soldering without a noseful of fumes! (J.R.) ❖

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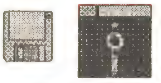

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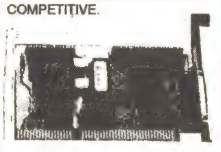

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Construction Project:

AN IMPROVED DSO ADAPTOR FOR PC'S - 3

To conclude the description of our new PC-based DSO adaptor Mark 2, here is a guide to using it in conjunction with the new and enhanced 'Version 3.0' software package available from David Jones.

by JIM ROWE

Just before we discuss using the new DSO adaptor, there's one aspect of the calibration process I forgot to mention in the second of these articles. This is calibration of the timebase, using trimmer capacitor CV5 at the centre rear of the PCB.

Frankly, this aspect of the DSOA's calibration is not likely to be of much relevance to most builders and users of the project. Because the master timebase oscillator is held very close to 2MHz by quartz crystal X1, the timebase 'speeds' or sampling rates are already much more accurate and stable than those in a conventional analog scope. Typically they'll be within a few parts in 10,000 — even if you simply leave the trimmer in its mid-range position and forget it.

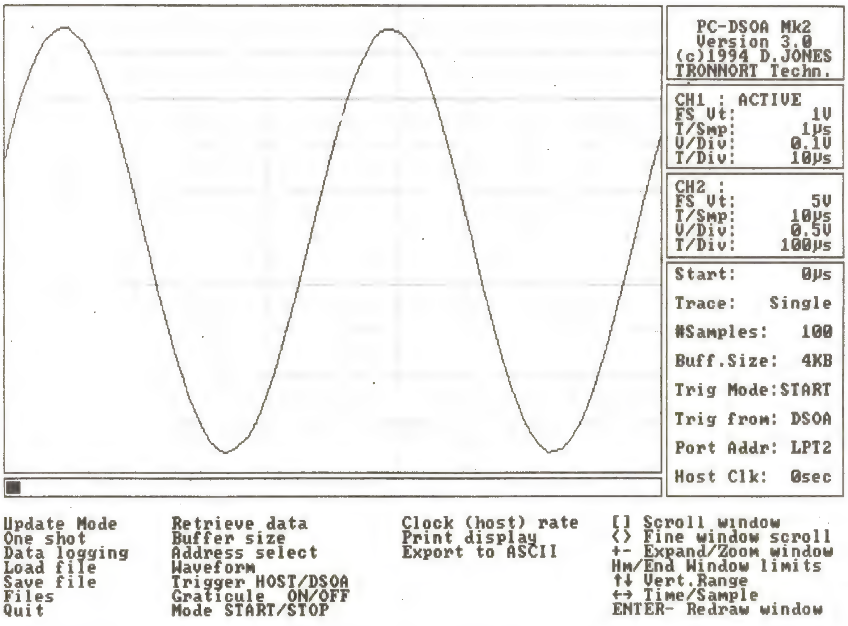
This is obviously more than sufficient for most measurements with a DSO, and in any case it represents a time resolution which is significantly better than the DSOA and its software are capable of displaying.

However if your needs are specialised, and you *do* want to adjust the timebase oscillator to its highest accuracy, you'll need access to a digital counter with a high-accuracy timebase of its own. A suitable combination would be the Low Cost 1GHz Counter of April 1993, fitted with the Hi-Res Mod of March 1994, and using the TV-Derived Frequency Reference (October-November 1993) as its timebase.

Once you've set up these instruments, or a counter with equivalent accuracy, alongside the DSOA, the calibration procedure is very simple. All you need do is measure the exact frequency of the '1us' timebase signal (at the rearmost pin on the row between U6 and U3/4/7), and adjust CV5 with an insulated alignment tool until the frequency measures as close as possible to 1.000000MHz.

Note that it's best to measure the 1MHz (1us) output from the timebase divider chain, rather than the 2MHz signal from the oscillator itself, as this avoids disturbing the oscillator due to loading effects. The earthy side of the counter used for this measurement should be connected to the 'E' pin on the rear of the DSOA board, between C10 and R22.

This one measurement and adjustment sets all of the timebase speeds at once, since they're all derived from the same oscillator and effectively 'locked' by the divider chain. And with that out of the way, we can now turn our attention to using the DSO Adaptor in practice.



```
PC-DSOA Mk2
Version 3.0
(c)1994 D.JONES
TRONNORT Techn.

CH1 : ACTIVE
FS Vt:          1V
T/Smp:         1µs
V/Div:        0.1V
T/Div:        10µs

CH2 :
FS Vt:          5V
T/Smp:        10µs
V/Div:        0.5V
T/Div:       100µs

Start:         0µs
Trace:      Single
#Samples:      100
Buff.Size:     4KB
Trig Mode:START
Trig from:    DSOA
Port Addr:    LPT2
Host Clk:     0sec

Update Mode     Retrieve data       Clock (host) rate   [] Scroll window
One shot        Buffer size         Print display       <> Fine window scroll
Data logging    Address select      Export to ASCII     +- Expand/Zoom window
Load file       Waveform                                Hm/End Window limits
Save file       Trigger HOST/DSOA                       ↑↓ Vert.Range
Files           Graticule  ON/OFF                       ←→ Time/Sample
Quit            Mode START/STOP                         ENTER- Redraw window
```

This screen dump from David Jones' DSOA version 3.0 software shows a 20kHz sinewave as captured by the DSO Adaptor Mk2. It was printed out using the screen capture program 'Pizazz', as mentioned in the text.

Using it

If you team your new DSO Adaptor with David Jones' DSOA improved software, Version 3.0, you'll find that operation is surprisingly straightforward — and not very different from using a conventional analog scope. The main difference is that the DSOA is by its very nature a *storage* scope, and with the software you'll be able to not only save the captured waveforms on disk and recall them later, but also print them out to keep a nicely annotated 'hard copy' record.

Many of the controls on the DSOA itself are used in a very similar way to those on a conventional scope — like Input Coupling, Trig Polarity and Trig Level. The Trig Source switch is also very similar, allowing you to choose either the vertical signal itself (Int) or another external signal (Ext) as the source used to trigger sampling.

Vertical Range switch S2 and Time/Sample switch S8 are used in a very similar way to the vertical and timebase switches of an analog scope. The main differences here are that (a) the Vert Range switch is marked in terms of volts for *full-scale* deflection, rather than volts per graticule division, and (b) the Time/Sample switch is really selecting the sampling clock, even though it has much the same effect as a conventional timebase control.

When you're using the adaptor with the DSOA V3.0 software, the screen automatically displays the more familiar Volts/Div vertical calibration, *provided* that you update it by selecting the FSD range you've set the hardware to. The same applies to the time calibration — if you select the Time/Sample setting to match the range selected by S8, the software automatically displays the Time/Division horizontal calibration, according to the number of samples you're displaying at any time.

The only other thing to remember about the Time/Sample switch is that since it's really controlling the sample rate, you must ensure that you set it high enough to get good resolution of the signal you're interested in. Although Nyquist's Theorem talks about the need to take at least two samples per cycle, with a DSO this really refers to the highest frequency *component* in the signal — not its fundamental.

In practice, this means that with a simple real-time sampling system like the DSOA, you really need to sample at least 10 times higher, and preferably 20 times higher than the signal frequency in order to get a good idea of its true waveshape. So with most signals, it's best to start with the Time/Sample switch at maximum (1us), and only reduce it to lower settings if you need to, in order to 'compress' the display and see more of the waveform on the screen at once.

Note that if you DO find yourself needing to look at signals near the top of the DSOA's frequency range, where you're inevitably getting only about 10 samples/period (even on the highest 1us/sample setting), you should expect some apparent waveform distortion due to the sampling process itself. This is illustrated in one of the sample waveforms shown (the one of a 102kHz sinewave); you can see how the waveform reconstruction becomes somewhat crude and 'triangular', and in this case varies from cycle to cycle due to the varying phase relationships between the sampling clock and the signal itself.

It would be possible to remove this 'sampling distortion' by software interpolation and/or averaging, but the DSOA software doesn't have this capability as yet.

Note too that because the DSOA's maximum sampling rate is 1MS/s, it cannot capture events which take place in less than a microsecond — even though the bandwidth of its vertical amplifier is about 600kHz, and it has an effective risetime of around 200ns. So a captured waveform will actually have minimum *apparent* rise and fall times of 1us, as you can see from another of the sample waveforms. Any events which occur between one sample and the next are 'lost' in the sampling process.

As mentioned previously, the green 'Sampling' LED indicates when signal sampling is actually taking place. If it isn't glowing, even though the software may be displaying a waveform, the reason is likely to be that the DSOA isn't triggering for some reason. You may need to adjust the Trig Level control, for example. (When triggering isn't taking place, the screen simply displays the samples left in the DSOA's memory from the last time it *did* do a sampling sequence.)

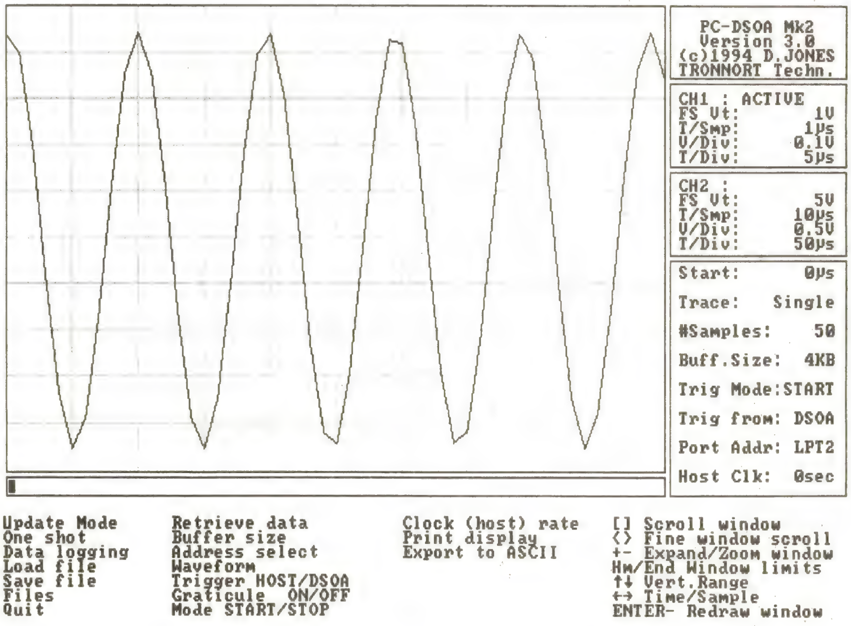
The 'Reset' button is to 'wipe the DSOA's slate clean', and prepare it for a new sampling sequence. If you have the DSOA set for signal triggering and in Start mode, resetting will automatically trigger off a new sampling sequence from the first appropriate signal transition.

Of course at times you may wish to disable signal triggering, and initiate sampling yourself, using the 'Man Trig' button (or using the DSOA software's 'PC Trigger' mode). You can disable the signal triggering in a couple of different ways: by switching Trig Source to 'Ext', without an external trigger signal actually connected, or by simply turning the Trig Level pot to maximum (so the triggering level is set beyond the signal's normal range).

Stop mode

Until now, we've really been talking about the DSOA with its Trig Action switch set to the 'Start' position — which produces operation very similar to that of a conventional analog scope. When triggering occurs, sampling begins and we capture what happens immediately *after* the triggering event. But if you move this switch to the 'Stop' position, the DSOA can operate in a different way — a way that allows you to see what happened in the time period just *before* the triggering event. This sometimes-very-handy feature can really only be provided on DSO's, and is often called *pre-triggering mode.*

To use the DSOA in this mode, you first turn the Trig Action switch to Stop, and then press the <M> key on the PC keyboard to let the software know you've changed mode. Then you start the DSOA sampling yourself, by either pressing the Man Trig button or alternatively by pressing the <O> key (for one-shot sampling). The DSOA's green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PC-DSOA Mk2
Version 3.0
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TRONNORT Techn.

CH1 : ACTIVE
FS Vt:        1V
T/Smp:       1µs
V/Div:      0.1V
T/Div:       5µs

CH2 :
FS Vt:        5V
T/Smp:      10µs
V/Div:      0.5V
T/Div:      50µs

Start:       0µs
Trace:    Single
#Samples:     50
Buff.Size:   4KB
Trig Mode:START
Trig from: DSOA
Port Addr: LPT2
Host Clk:   0sec
```

Another screen dump printed via 'Pizazz', this time showing a captured sinewave at about 102kHz. Note the sampling distortion visible in particular at the peaks of the wave. The cause of this distortion is also discussed in the text.

sampling LED will glow, showing that sampling is taking place.

What happens now depends on your Trig Source selection: either a signal event or an external trigger signal event can be made to STOP this sampling — and when this happens, the samples left in the DSOA's RAM buffer (which can then be read out for display) will represent what happened to the signal just BEFORE the trigger event.

How *long* a time period you've captured before the trigger event occurred will obviously depend on your Time/Sample setting. For example if you have the Time/Sample set for 1us per sample, you'll have captured the events which took place in the last 32.768ms (32768 x 1us) before triggering. If you had instead set the Time/Sample switch to 10us per sample, you'd have captured events in the last 327.68ms — get the idea?

The main point to grasp about Stop mode is that you have to initiate sampling either manually or from the PC (via the <O> or <U> keys), because in this mode the signal-derived triggering forces the DSOA to *stop* sampling.

By the way, it's important to note that in Stop mode, you must really set the DSOA's memory depth to 32K — the full depth of the memory chip — and the software setting to match. This is necessary because the software needs to be able to cycle through the full address range of the memory (beginning from where sampling stopped), in order to bring back all of the pre-trigger event samples.

Software update

As mentioned in the first article, David Jones (the designer of the original DSO Adaptor) of Tronnort Technology has written a new and expanded version of the updated software for his own adaptor, especially to suit our new model. The new Version 3.0 software takes full advantage of the extra features of the Mk2 Adaptor, and offers many 'user friendly' features of its own.

The new Version 3.0 DSOA Software is available directly from Tronnort Technology, of 12 Copeland Road, Lethbridge Park 2770. It costs only $30 plus $5 to cover postage anywhere in Australia, and therefore provides an economical way to put your DSO Adaptor Mk2 to very practical use.

We understand that some kits for the DSO Adaptor Mk2 may include the current version of this software, by arrangement with Tronnort. However kit constructors may still wish to register with Tronnort as a user of the software, so David Jones can keep you posted on any further upgrades he releases in the future.

Software functions

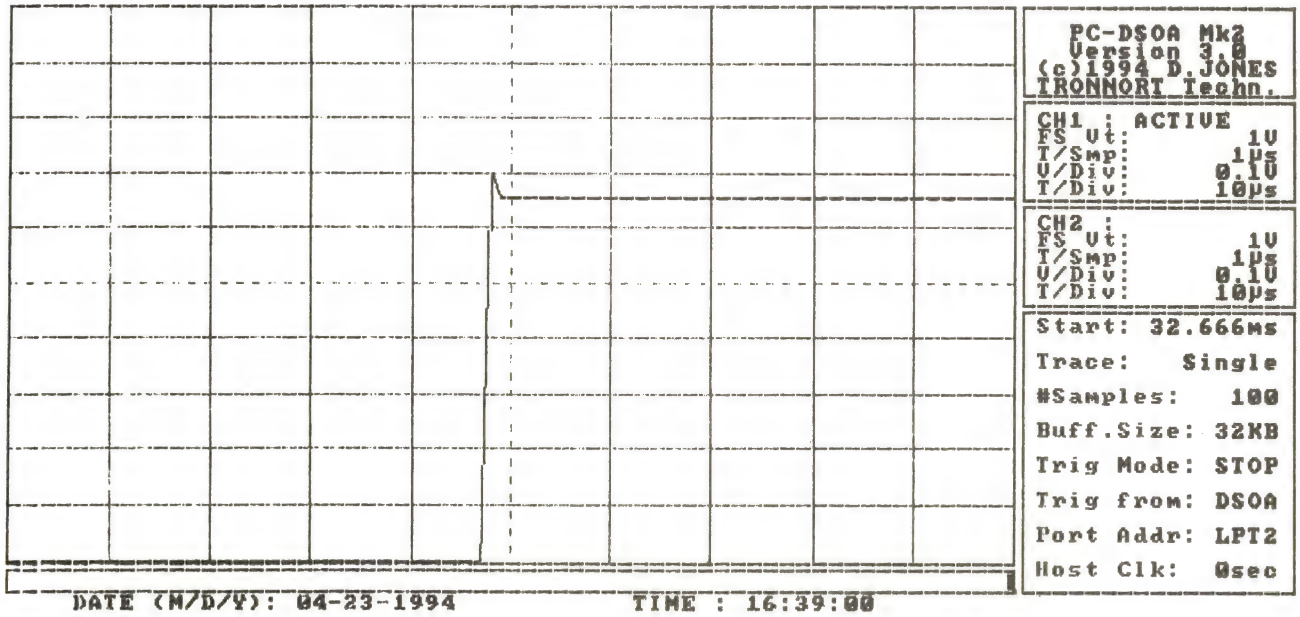
That just about completes our description of the DSO Adaptor Mk2 itself; all that remains are a few further comments about the matching enhanced V3.0 software, written by David Jones.

There's no need to go into great depth here, because David includes a quite detailed and comprehensive 'README' file on his software disk. So I'm only going to offer a few additional (and hopefully helpful) comments of my own.

Basically, David's software is very intuitive and easy to use. It provides three basic modes of interacting with the DSOA, two of which we've already discussed during the calibration procedure: One-shot mode (<O> key), which initiates a single sampling and retrieval sequence, and Update mode (<U> key), which produces a continuous 'real time' series of sample/retrieval sequences, until you press the <ESC> key.

How rapidly the waveform display is actually updated in 'U' mode depends to a large extent on the clock speed of your computer, and of course on the sampling rate you have selected in the DSOA itself. To speed things up, David Jones has arranged the software so that in this mode, it only retrieves enough samples to maintain the screen display, rather than the full memory depth you've set. Typically with a 12MHz AT machine and 500 samples displayed, you get around three updates per second; this speeds up to about six-eight per second if you're displaying the minimum of 50 samples.

By the way at the *end* of a one-shot '<O>' sampling, and also when you end up an Update or '<U>' sequence, the software *then* does a full reading of the DSOA's effective memory depth, to



```
PC-DSOA Mk2
Version 3.0
(c)1994 D.JONES
TRONNORT Techn.

CH1  : ACTIVE
FS Vt:        1V
T/Smp:       1µs
V/Div:      0.1V
T/Div:      10µs

CH2  :
FS Vt:        1V
T/Smp:       1µs
V/Div:      0.1V
T/Div:      10µs

Start:  32.666ms
Trace:    Single
#Samples:    100
Buff.Size:  32KB
Trig Mode:  STOP
Trig from:  DSOA
Port Addr:  LPT2
Host Clk:   0sec

DATE (M/D/Y): 04-23-1994          TIME : 16:39:00
```

Not a screen dump, but a printout from the DSOA software itself, via a somewhat elderly Epson compatible dot matrix printer. The waveform visible is the trigger output from the author's 1MHz Pulse Generator, captured in Stop mode. The waveform's relatively slow apparent rise time is due to the DSO Adaptor's minimum sampling resolution of 1us.

allow you to examine the full set of samples. So the software gives you the 'best of both worlds' — fast screen updating, but full memory reading as well.

The third mode of operation is Retrieve mode, which is activated by pressing the <R> key. This does not initiate a new sampling sequence at all, but merely gets the software to retrieve the existing samples from the DSOA's memory. It's therefore handy for retrieving a full waveform record after you've done manual sampling, in either Start or Stop mode, or for doing a second retrieve of samples if you suspect the first retrieve may have been garbled in some way.

The waveform file disk saving and retrieval functions of the software are quite straightforward, as is the printing function. In fact the main thing to remember, when you're using the software, is to keep it updated on the DSOA hardware settings as you change them. If you do this, the software will not only give you an accurately calibrated display, but will often flag up any potential problems.

By the way, since I wrote the first of these articles, David Jones has added the printing function. This is written to suit the popular Epson-compatible dot matrix printers, and seems to work well with most of these (although not with one of ours — a Star NX-1000, for some reason).

At present this is the only type of printer handled, but he's hoping to provide it with the ability to drive HP-Laserjet II compatible printers soon.

In the meantime, as far as we have been able to determine the Version 3.0 DSOA software is quite compatible with popular DOS-based 'screen grabber' software, like *Pizazz*. This kind of program allows you to capture the screen and DSOA waveform at any time, and either print it out (on almost any kind of printer), or convert it to one of the many popular image formats for importing into another software package.

So using a screen grabber package like *Pizazz*, there's no problem in getting 'hard copies' of your DSOA waveforms, or feeding them into other packages. This was in fact the technique used to obtain the screen grabs shown in this article.

That's about it, I think. All that remains is to thank David Jones for his co-operation in developing the modified version of his enhanced software, to support this project, and to wish builders success in building and using their DSO Adaptor Mk2. I trust you'll find it as useful as I have, already! ❖

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READER INFO NO. 17

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With PC Probe™ you'll save time and money when your PC starts acting up. In one easy-to-use package you get Diagnostics, Virus Protection (for over 700+ known viruses), Benchmarks (including the famous LandMark System Speed Test™), Performance Enhancement Utilities, and System Information. Combined, this arsenal of tools will keep your system up and running at peak performance and remove the mystery about what's inside.

PC Probe diagnostic testing quickly isolates the source of hardware problems, even locating bad RAM chips. It tests system board, RAM, video, keyboard, com ports, floppy and hard drives, Ethernet card and more. Run PC Probe tests in batch mode or single pass, remote or on-site.

THE 5 MINUTE SOLUTION TO FLOPPY DRIVE FAILURE

With **Alignit™** you can *clean, diagnose, and align* your floppy drives in minutes *without* a scope. Patented technology requires only screwdriver to perform ANSI-accurate alignments (.3 mil).

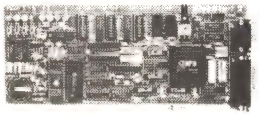
Alignit is *ideal for corporate users* with 2 or more PCs because it includes a **"GOLD STANDARD"** feature so you can align all your PCs to the same in-house standard, *guaranteeing that all your floppies are perfectly interchangeable* between PCs.

80% of all floppy drive failures can be fixed with Alignit so don't replace your drive, save time and money instead. Includes dual size floppies, (both high and low density) and no-mess pre-lubricated cleaning diskettes (both sizes) good for 180 uses. Replacements and single drive size versions available. For al PCs and compatibles.

PC WON'T BOOT? THEN JUST KICKSTART IT!

Don't replace your motherboard, don't call service, use **KickStart 2™**. When serious hardware problems occur, nothing gets you up and running as fast. KickStart 2 *measures power within 2.5%* on all four voltages, *shows Power-On Self-Test* (POST) failure codes, and features *on-board ROM-based diagnostics* allowing you to *determine and remedy the problem quickly, easily, and inexpensively!*

Built-in serial and parallel I/O *allows for testing via modem*, or simply logging results to a remote terminal, printer or laptop. You can configure your own test routines and store them in KickStart 2's battery backed-up CMOS RAM saving valuable setup time. Includes serial and parallel loopback plugs and Landmark JumpStart AT ROM BIOS for testing PCs that don't issue POST codes. KickStart 2 *tests your system regardless of O/S (even UNIX).*



On-board switches, LEDs, and digital displays allow complete control over testing in systems lacking video or disk (ideal for motherboard or system burn-in).

Kick Start 2 is the *ultimate SECURITY CARD* too! With both supervisor and user levels of password protection, you can prevent unauthorised use of your PC and accidental running of destructive tests.

HARD CORE TESTING FOR PROFESSIONALS

Landmark/SuperSoft **Service Diagnostics**$_{TM}$ is ideal for professionals requiring the *most exhaustive diagnostic* test capabilities. Each module is CPU specific, including PC, XT, AT, 386/486, and PS/2. Since 1981 major manufacturers like Wang, Xerox, Prime, Sony, DEC, NEC, and NCR have relied on Service Diagnostics to tackle their tougest operating problems.

Intended for professional service and repair technicians, Service Diagnostics is also *easy to use* for the novice. Clear, concise on-line help and intuitive menus make finding system problems a breeze. Tests all CPUs, math chips, all memory, floppy, fixed and non-standard disk drives, standard/non-standard printers, system board, video, com ports and all keyboards. Utilities include low-level reformat, log bad sectors, edit bad sector table; the partition editor allows you to set up multiple partitions; *back-up program* transfers hard disk image on unformatted floppies and allows for *restore* after reformat.

Ideal for UNIX and other operating systems, the *self-booting version* doesn't require DOS. The manual offers troubleshooting tips to the component level. Also available in a complete Kit including; all CPU specific software, dual size floppy alignment software (see Alignit), and PC/XT & AT ROM POSTs. ***Winner of the PC Magazine Editor's Choice Award in August 1990.***

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READER INFO NO. 18

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JAYCAR BARGAINS FOR JULY

SURROUND SOUND SPEAKERS!!!

NEW

If you want to experience that amazing cinema sound in your home you will need a surround sound processor and surround sound speakers. A surround sound system requires two front speakers (you can use your hi fi speakers for these), two rear speakers and a centre speaker. We now stock the fabulous ACCUSOUND bookshelf speakers and centre speaker. These are prebuilt (not kits), are cheaper than previous kits and sound fantastic.

BOOKSHELF / REAR SPEAKERS

Battery shown to indicate scale

These speakers are exceptional! They handle an amazing 50WRMS and they are only 260mm high! They incorporate a 4" high compliance polypropylene woofer and a quality 25mm dome tweeter.

Use them as bookshelf speakers, or as rear speakers in a surround system. (We think they are as good as, if not better than the SA50 speaker kit they replace. The SA50's sold in a kit form for $369 pair and only handled 30WRMS, and you had to build them!)

They are finished in **black woodgrain**, with push terminals on the rear. Call into any Jaycar store for a demo.

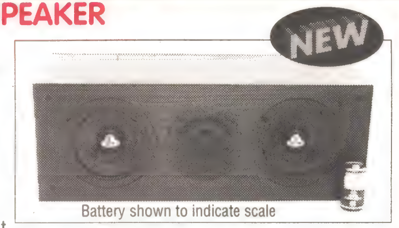
Specifications:

Power handling:	50WRMS	Frequency range:	70Hz to 20kHz
Sensitivity:	89dB	Bass drivers:	4" polypropylene
Tweeters:	25mm dome	Crossover:	first order bypass filter
Weight:	4.6kgs per speaker	Dimensions-mm:	260(H)x160(W)x 215(D)

Cat. CS-2430 **ONLY $299 / PAIR**

CENTRE LOUDSPEAKER

NEW


Battery shown to indicate scale

This speaker has two 4" polypropylene drivers which are the same as in the bookshelf speakers. It also incorporates a dome tweeter for highs. All drivers are completely shielded for use near the TV. This eliminates colour distortion on the TV. It handles a massive 50 watts, however we doubt you will ever need to use this sort of power. It's finished in black woodgrain with black speaker cloth mounted on a grille.

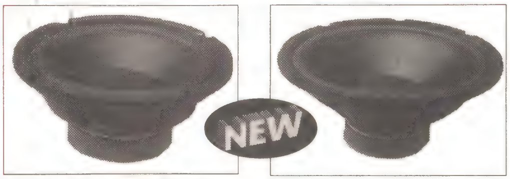
Specifications:

Power handling:	50WRMS	Frequency range:	80Hz to 20kHz
Sensitivity:	89dB	Bass drivers:	2x4" polyprop shielded
Tweeter:	25mm dome shielded	Weight:	7kgs
Dimensions-mm:	160(H)x435(W)x215(D)		

Cat. CS-2432 **ONLY $269**

New Polycone 6" & 12" Woofers

WITH RUBBER EDGE AND NEW SPECIFICATIONS


NEW

6" Speaker Specifications - •Power Handling: 30WRMS •Freq Response: 59-3kHz •Resonant •Frequency: 59Hz •Sensitivity: 86dB 1W/1M •QMS: 3.92 •QES: 1.3426 •QTS: 1.000 •VAS: 15.4L

Cat. CW2108 Now Only $29.50

12" Speaker Specifications - •Power Handling: 80WRMS •Freq Response: 24.5-4kHz •Resonant Frequency: 24.5Hz •Sensitivity: 90dB 1W/1M •QMS: 3.04 •QES: 0.3691 •QTS: 0.3291 •VAS: 175.5L

CW2130 Now Only $82.95

JUPITER 2 UHF PARABOLIC ANTENNA

This antenna looks like a satellite dish and offers far superior reception than what you would imagine. And at around $50, if far cheaper - "$ per dB gain" than conventional UHF antennas. It's suitable for fringe areas and its not as directional as some antennas, which is a benefit for fringe locations. Its also lightweight, needs no assembling and is easy to use.

SPECIFICATIONS:
•Channels: 21 to 69 •Gain: 16 to 19dB •Bands: 4 and 5 •Dimensions: 580mm diameter
Supplied with mounting bracket. Requires "F" connector for cable entry Cat PP-0640 $1.20

Cat. LT-3188 **ONLY $49.50**

300 WATT SINEWAVE INVERTER

True Mains Power from a battery........
This new Sinewave Inverter is made in Australia by Power Conversions Pty Ltd. A sinewave inverter generates mains type power with the correct peak and mean voltages guaranteeing reliable, optimum performance for the connected electrical equipment.

FEATURES •300 watts continuous •compact •lightweight •rugged and reliable •stable output power •efficient - 82% •silent

TOTAL PROTECTION •input over and under voltage electronic short circuit •reverse polarity •over temperature •circuit breaker overload protection •electronic current limiting

SIMPLE TO USE •connect to a battery and switch on, it's now in standby mode - plug in the appliance and the unit will automatically turn on

TWELVE MONTHS WARRANTY

SPECIFICATIONS •input voltage: 12VDC,10-14.5VDC •output voltage: 240VAC +/-6% •output frequency: 50Hz +/-10% •output power: 300 watts, 450 watts peak •continuous DC current: 30 amps •THD: 3% resistive loads •efficiency: 82% peak, 70% at 10% load •power factor: +/-0.75 •idle state consumption: 0.8 watts •max AC lead length: 10 metres •size: 260 x 230 x 105mm •weight: 3kgs.

Cat. MI-5030 **ONLY $699**

10 BAND PORTABLE RADIO

This radio features good tonal quality, and is ideal for listening to the races, football while gardening etc. It has AM, FM, LW and short wave bands covering 5.85MHz to 22.1MHz.

Features include: •LED tuning indicator •earpiece is supplied •3VDC power socket •telescopic antenna •operates from 2 x AA batteries (not supplied) •size: 175(L) x 85(H) x 40(D)mm.

Cat. AA-2210 **$29.95**

Digital Multimeter Price Breakthrough - Excellent Value!

BRILLIANT RANGE OF MULTIMETERS ALL OFFER UNBELEIVABLE VALUE FOR MONEY

For full specifications and list of all the features associated with each model see our 1994 catalogue.

Low Cost

1 YEAR WARRANTY

- 3.5 Digit 12.5mm High Display LCD
- Transistor Test
- Diode Test
- 10 Amp Current

QM-1500 $29.95

30 Range

1 YEAR WARRANTY

- Large Display
- Transistor Test
- Audible Continuity
- 20 Amp
- Diode Test

QM-1300 $49.95

Freq. Counter

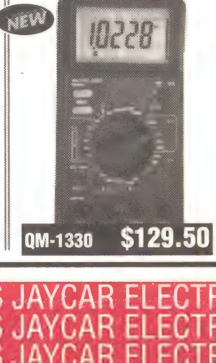
1 YEAR WARRANTY

- Transistor, Diode & Continuity Test
- Capacitance
- Auto Power Off
- Large Display •20 Amp

QM-1310 $79.95

4.5 Digit

- Freq Counter •20 Amp
- Transistor/DiodeTest
- Capacitance •Data Hold
- Large Display •Auto Power Off •Overload Protected •19999 Count



QM-1330 $129.50

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JAYCAR ELECTRONICS

10% Off Guardall Wireless House Burglar Alarms

See 1994 catalogue - page 54 for full details.

4 Sector Kit

•1 x receiver panel •1 x PIR •1 x reed switch •1 x remote •1 x 240 volt plugpack

Cat. LA-5220

Was $399.50 July $359.55

3 Sector Kit

•1 x receiver panel •1 x PIR •1 x remote controller •1 x 240 volt plugpack

Cat. LA-5221

Was $289.50 July $260.55

Plus 10% Off Extras

	cat	was	now
PIR	LA-5224	$99.00	$89.10
Remote	LA-5222	$44.95	$40.46
Reed Switch	LA-5226	$54.95	$49.46
Wireless Keypad	LA-5228	$89.50	$80.55

Camcorder Wireless Microphone System

With this microphone system you can be videoing someone 50 metres away and hear and record them talking as if they were standing right next to you. And it works well. It consists of • a receiver which mounts on the camcorder •An earpiece is supplied so you can monitor what is being said •A transmitter which clips on the belt of the person using the microphone. •Two microphones are supplied - one is a tie clasp type and the other is a small hand held type. See catalogue for full details.

Cat. AM-4065 Was $129.50 July $99.50

WOOFERS AND TWEETERS REDUCED

10" Black Cone Woofer

This is a quality woofer with foam roll surround, silver dust cover and grey ribbed cardboard cone. Listed below are all the specifications we have available. •Impedance: 8Ω •Power Handling: 60 watts •Res Freq. (approx): 38Hz •Freq Resp: 38 - 3kHz •Suitable Enclosure: 25L or more - sealed

Cat. CW-2117 Was $24.95 Now $17.95

Economy 1005 Piezo

This unit is similar to US-made piezos but is Asian sourced, and much lower in cost. Does not require a crossover. Handles 30V rms, which relates to 112 watts in 8Ω systems and 224 watts in 4Ω systems. Frequency response 3kHz - 35kHz, sensitivity 92dB.

Cat. CT-1907 Was $14.95 Now $10.00

Economy 1141 Piezo

WARRANTY 1 YEAR
SAVE $5

Another similar design to a US-made piezo at a much lower price. Does not require a crossover. Handles 30V rms which relates to 112 watts rms into 8 ohms and 224 watts rms into 4 ohms. Ideal for PA's, band work, etc. •Frequency resp: 2.5kHz - 35kHz •Sensitivity 92dB •Dim: 187 x 79mm

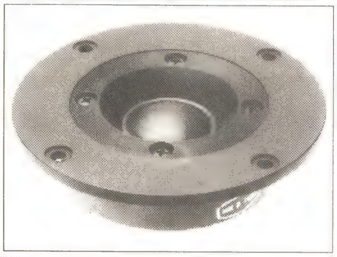
Cat. CT-1908 Was $19.95 Now $14.95

Re/sponse Dome Tweeter

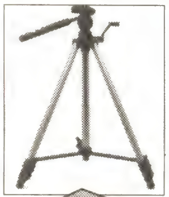
The Re/Sponse dome tweeter reproduces highs with smooth and detailed performance. It features ferrofluid injection in the voice coil gap which allows for increased power handling and greatly reduces failure due to high thermal transients. Specifications as follows. •Power Handling: 40 watts rms •Frequency Response: 1.5kHz - 21kHz •Resonant Frequency: 1.2kHz •Sensitivity: 94dB 1w/1mtr

SAVE $4.95

Cat. CT-2010 Was $24.95 Now $20



Large Tripod



Features: •two way pan head with quick-release plate and spring operated locking pin for camcorders •extra long stick •continuously adjustable by means of a crank with adjustable friction brake •tripod legs with vertical lever locks •cross bracing and closed channels - rubber feet •max extended height 131cm •retracted height 53cm

SAVE $10

Cat: AV-6535 Was $59.95

For July $49.95

"Tweetie Pie"

This amazing little piezo screamer (57Lx33Hmm) emits a 116dB wail. Its virtually unbearable, especially if mounted inside the car. Current consumption 200mA.

Cat. LA-5255 Was $17.95

Now $13.95

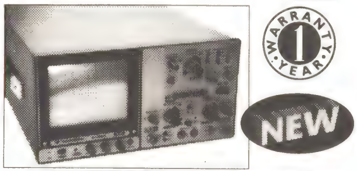
Extremely Low Cost Extension Car Speakers

CAR SOUND ON A 3RD WORLD BUDGET.

Whilst they are cheap, they work OK! The enclosure itself is moulded in a cheap plastic - so we do not recommend them for rear parcel shelf installations in cars in hot climates. The 4" wide range speaker has a pleasant sound about it though. They will handle about 5 watts RMS. Ideal for workshops, cool cars, sound blasters etc. Measure 130W x 25H x 63Dmm each.

Cat. AS-3150 Only $6.95 a pair

25mHz Dual Trace Cro

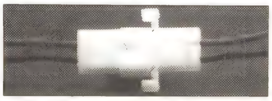


25mHz for 20mHz Price! New Model

Includes component tester and screen back lighting. Probes use QC1902 $39.50ea. See catalogue for full details.

Cat. QC-1900 $699

2 Pin Wired Plug & Socket



Two pin quick disconnect cable assemblies fitted with male and female connectors. Includes 45mm of cable for easy connection. Ideal for electrical connections for car stereo, communication equipment, speakers etc. Limited quantity.

Cat. PP-2032 $3.95 NEW

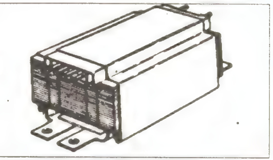
EVEREADY ANYWHERE LIGHT SLASHED

The Anywhere light runs on two "D" size batteries and is ideal for use in closets, stairwells, attics, basements, camping, cars - anywhere where you need some light. It incorporates an on/off switch. Size: 159(dia) x 50(deep) mm. These used to sell for around $25.00.

Cat. ST-3035 Cat Price $9.95 July $6.95

Transformer Bargain

NEW



Ferguson Brand PL222/40/1 Flat Pack.

Two secondary windings. Supplied with flying leads. Input - 240VAC: Output - Sec 1 13V 40VA / Sec 2 36V 40VA

Cat. MF-1040 A Bargain At $10

NEW DEALERS

ALBURY - NSW
Albury Audio Music
493 Swift Street
Albury 060 411 765

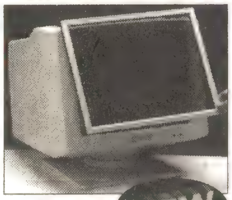
BRANXTON - NSW
Branxton Video World
57 Maitland Street
Branxton 049 381 475

JAYCAR ELECTRONICS

JAYCAR ELECTRONICS

NEW COMPUTER ACCESSORIES

MONITOR ANTI GLARE FILTER



This monitor filter features Anti-reflection and Anti-glare glass. It will cutout 100% of UV rays and helps to isolate X-rays. It will also enhance screen sharpness and contrast and cut daylight reflection. It is designed to work with 12-14" monitors and suits MGA, CGA, EGA, VGA and super VGA. Supplied with simple mounting hardware and a ground clip to stop dust buildup.

Cat. XC-5150 **$19.95** NEW

DESKTOP COPYHOLDER

NEW

This curved copyholder is fully adjustable for personal comfort. It has a tilting bail at the back to vary the reading angle and height adjustable document clip for different sized paper from A4 to foolscap to legal (up to 370 x 220mm). There is also a sliding rule to help you keep track of your place in the text. Colour is ivory.

Cat. XC-5152 **$19.95**

COMPUTER JOYSTICK

NEW

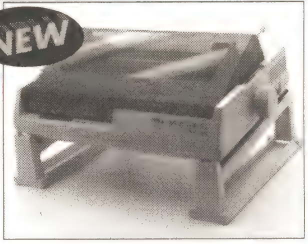
Unlike other joysticks, this joystick is extremely robust and can handle extreme treatment from the toughest of games players! Features include •3 sure action fire buttons •a positive response and self centering "stick". It is compatible with "IBM PC, XT, AT and compatibles. A compatible games card is required. It is supplied with cable and D15 plug and there is also X and Y calibration controls if required.

Size - base 130(W) x 100(D)mm. Total height 175mm.

Cat. XC-5156 **$36.95**

UNIVERSAL DESKTOP PRINTER STAND

NEW



- Fits any 80 or 132 column printer either rear or bottom fed.
- Angled forward for improved visibility of printouts and ease of operation.
- Non slip felt prevent skidding and scratches on your desktop.

Cat. XC-5158 **$12.95**

COMPUTER SERVICE TOOL KIT

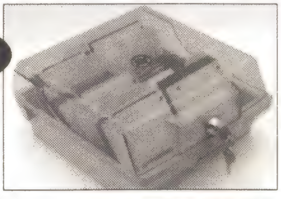
NEW

This kit contains all the tools you need for servicing computers, PC boards, peripherals and all types of electronic equipment. These are mounted securely by elastic strap holders and supplied in a padded black vinyl zipper case. Kit includes: •1/4" nut driver •3/16" nut driver •IC extracter •14-16 pin IC inserter •tweezers •T10/T15 torx screwdrivers •pearl catch •No 1 Phillips screwdriver •No 0 Phillips screwdriver •3mm slot screwdriver •5mm slot screwdriver •vinyl zipper case

Cat. TD-2040 **$37.95**

3.5" Floppy Diskette Storage Box

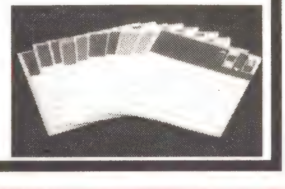
NEW



This high impact plastic storage box will keep your disks safe and free from dust, dirt etc. Holds "100" disks and has a lockable (2 keys supplied) clear perspex lid for added security. Comes complete with plastic file dividers.

Cat. XC-4690 **Don't pay $12.95 - Jaycars price $9.95**

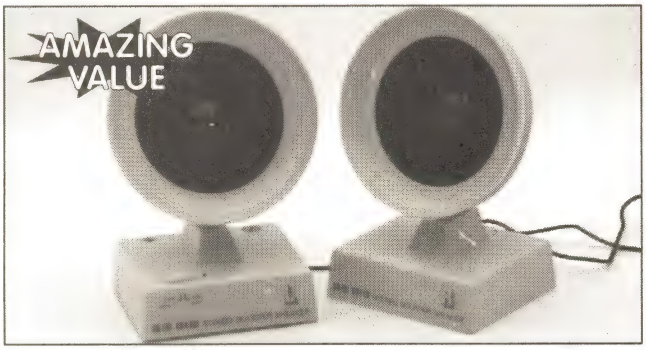
3.5" REPLACEMENT DISK STICK ON LABELS



These are hard to get, but we have some. These are the same as supplied in each box of disks. Consists of 2 of each colour - yellow, red, green, blue & pink.

Cat. XC-4780 **Pkt 10 Only $1.20**

AMPLIFIED SPEAKER BARGAIN!



NEW

These speakers are designed to work with a Walkman or portable CD, or even your computer. We were offered a quantity of these & simply could not believe the price. They are about half what they should be.

They look like something from the future, they are bright yellow in colour, and the top part where the speaker is can be tilted back and forward. Each unit requires 2 x AA batteries (not supplied). Power output is a huge 6 watts and the speaker diameter is about 80mm or 3".

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REF: EA FEB/MAR 1994

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Another surplus stock purchase, lightweight 3.5mm mono plug (use an adaptor or solder on a stereo plug for stereo headphones). 32 ohm impedance. Limited quantity available

Cat AA-2000 **$1.95**

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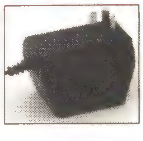

This plugpack is used to a large extent with modems and answering machines. In most cases this one will replace a 9V AC plugpack. Terminates to a 2.1mm DC plug.

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See 1994 catalogue - Page 113 - for full details.

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PB-8812	Terminal Strip	$12.50	$10.62
PB-8814	830 Tie Points	$17.50	$14.87
PB-8816	1660 Tie Points	$42.95	$36.51
PB-8818	2390 Tie Points	$53.95	$45.86
PB-8820	3220 Tie Points	$72.50	$61.62
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Alpha numeric grid, pre-drilled 0.9mm, 2.5mm spacing. 95mm wide x 3 handy lengths

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5.25"	DSHD-F	Cat: XC-4733	$9.50 Pkt 10	Was $9.95
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3.5"	DSHD	Cat: XC-4738	$10.50 Pkt 10	Was $12.95
3.5"	DSHD-F	Cat: XC-4739	$12.50 Pkt 10	Was $14.95

NEW KITS & BOOKS NEW KITS & BOOKS NEW KITS & BOOKS

Low Cost Temperature Controller Kit REF: EA 7/94

NEW

This compact controller is capable of switching 10 amps at 240VAC under the control of a temperature sensor. The temperature setting is calibrated manually, and can be set from sub-zer temperatures to around 100 degrees celcius or more. Ideal applications include thermostats for home brewing, hydroponic gardens, aquariums etc. A PCB jumper pin allows the unit to be set to switch the circuits relay either on or off when the desired temperature is exceeded. The Jaycar kit comes complete with case, PCB, moulded mains plug and socket lead (2.5m either side), all specified electronic components and fast response mini glass bead thermistor. Beware of other kits with non specified slower response thermistors.

Cat. KA-1763 ONLY $44.95

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This informative book gives you an overview of whats involved in alternative methods of generating your own electricity for use in your home. The chapter headings are:

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9 Pin Ext - 2 m	D9 plug to D9 socket	PL-0871	$12.95	$7.95	$5
VGA Ext - 2 m	D15 Hi D plug to socket	PL-0873	$14.95	$9.95	$5
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July sellout Only $20

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Solder terminals

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DRAKE'S NEW SW8 SHORTWAVE RECEIVER

Respected US communications equipment maker R.L. Drake has recently returned to the amateur/shortwave market, after a break of a few years. Its latest product in this area is the new SW8 World Band Shortwave Receiver, which offers near-communications receiver performance (plus FM and air-band reception) in a convenient portable package.

by JIM ROWE

Those of us who have an interest in radio communications and have also been around a while will have no difficulty remembering the name R.L. Drake. Founded back in 1943, the company was one of the leading US makers of communications receivers and amateur radio gear back in the 1950's, 60's and 70's, and its equipment was highly respected around the world. But in the early 1980's it seemed to drop from sight, at least as far as amateurs and shortwave listeners were concerned.

Apparently the company decided at that time to scale down its activities in this market, and move into the flourishing satellite communications area instead. It did well there, too, becoming just as respected for its satellite receivers.

About three years ago, though, the US satellite equipment market started to plateau, while interest in shortwave listening began to surge again worldwide. So Drake decided to re-enter the market it had left before, and in 1991 it released the R8, a high performance communications receiver with all of the latest features and facilities.

The R8 was very well received, particularly in the USA and Europe, and seems to have firmly re-established Drake in its old market. As a result the company has now been prompted to release another model, the new SW8 — described as a 'portable, world band shortwave receiver'.

The new SW8

The SW8 is lower in price than the R8, and perhaps designed for the serious shortwave listener rather than the professional user. It's a less pretentious receiver than the R8, with not quite as many of the fancy controls needed for full-scale professional work. But instead it offers other attractive features, such as FM stereo and air-band reception, and the ability to operate from six inbuilt 'D' cells. So in many ways it's a different *kind* of receiver to the R8, rather than a scaled-down version of it.

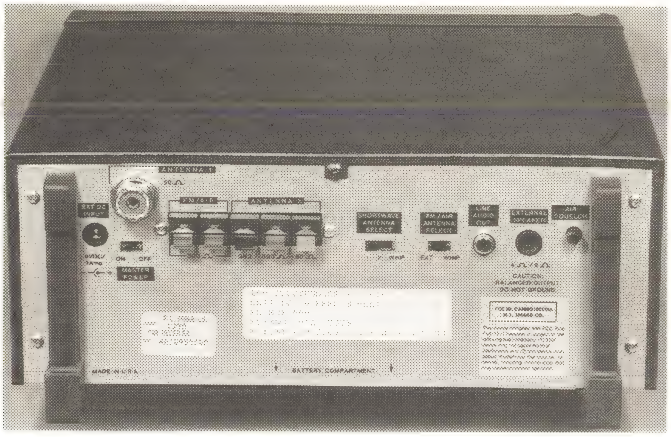
The SW8 measures 292 x 133 x 330mm, and weighs a modest 3.9kg (less batteries). It's finished in an elegant matt black, and has an LCD panel with switchable orange backlighting and large, easily read indications. Other salient features include a combination carrying handle/tilting bail, and a telescopic whip antenna which 'parks' inside the case at the top left-hand corner of the front panel.

The control panel is neat and uncluttered, with only three knobs (volume/power, tone and tuning). All remaining functions are controlled via a keypad, with 16 small keys plus a pair of larger 'increment/decrement' tuning keys. One of the 16 smaller keys is a function or 'shift' key, which provides a second function for each of the remaining 15 keys.

Three of the smaller keys are for band selection, being marked 'BCB' (for broadcast band), 'Air' and 'SW'. The FM broadcast band is accessed by means of a second press on the BCB key. Other key functions include control of IF bandwidth (6.0, 4.0 or 2.3kHz); AGC decay (slow/fast); RF attenuator (20dB, in/out); display backlighting (lamp on/off); and whether a conventional or synchronous detector is used, for AM reception on the broadcast and shortwave bands. (The synchronous detector can reduce distortion due to selective fading, and give clearer reception of international broadcasters.)

Using the function key with the main 3 x 4 group of smaller keys allows direct keying-in of a wanted frequency, for instant access. On the main 500kHz - 30MHz band it's also possible to jump directly to the lowest frequency in one of the traditional 'metre' shortwave bands, by pressing the 'SW' key twice and then keying in the metre-band designation (i.e., '31'). The only small irritation here is that the SW8's LCD display boldly in-

DRAKE
SW8 World Band
Shortwave Receiver
15698.6
SW
KHz
TONE
VOLUME
POWER
BAND
TUNING



A rear view of the SW8 receiver, which provides both an inbuilt telescopic rod antenna and a choice of high or low impedance external antennas.

sists on 'meter', the American spelling. Still, the set *is* made in the USA...

The main increment/decrement tuning buttons have a fixed tuning step of 100kHz for the shortwave and FM bands, 12.5kHz for the aircraft band and either 10kHz or 9kHz (selectable) for the AM broadcast band. The rotary tuning knob resolution is similarly fixed, at 100Hz for the AM broadcast and aircraft bands, and also AM mode on the shortwave band. When you change to USB or LSB on the latter band, the resolution increases to 50Hz. FM tuning resolution is 50kHz.

As with most modern microprocessor-driven communications receivers, the SW8 also provides an array of tuning memories for storing often-used frequency settings. In this case there are 70 memories, and each stores frequency, mode, bandwidth, AGC setting, RF attenuator setting and whether or not the synchronous AM detector is being used. Once the information has been stored in the memories, the SW8 can also be programmed for memory scanning. The receiver also offers dual time-zone digital clocks, and also dual timers for programmed reception...

The rear of the SW8 case is fairly typical of a modern receiver, with quite an array of connectors and preset control switches. Perhaps the most important input connector is that for external power, which accepts 9V DC at a nominal 1A. This normally accepts the plug and cable from the outboard power supply which comes with the receiver.

For external antenna connections and configuration the receiver has an SO-239 coax socket, five spring-loaded terminals and a pair of slide switches. For the AM broadcast/shortwave bands you can select either the internal rod, or either of two external antennas: 'Antenna 1', 50 ohms via the SO-239 socket; or 'Antenna 2', either 500 or 50 ohms via three of the spring terminals. Similarly for the FM/aircraft bands you can select either the internal rod antenna again, or an external 300-ohm balanced antenna (via the remaining two spring terminals).

The remaining rear-panel connnectors are a socket for an external speaker (balanced with respect to ground), and a fixed line-level audio output for recording, etc., with a nominal output of around 300mV. There's also a squelch control for the aircraft band, and a 'master power' switch which over-rides the one on the front panel. A separate 3mm headphone socket on the left-hand side of the receiver case allows stereo reception on the FM band, if stereo headphones are available.

The SW8 uses double conversion on the main 500kHz - 30MHz band, with initial up-conversion to a first IF of 55.845MHz for high image rejection, and then conversion down to a standard second IF of 455kHz. Single conversion is used on the FM and aircraft bands, with an IF of 10.7MHz.

Rated sensitivity of the SW8 for AM reception is less than 2uV over the 500kHz - 30MHz band, and less than 4uV over the 118 - 137MHz aircraft band. For SSB the rated sesnsitivity over the HF band is less than 0.5uV, while that for the FM broadcast less than 4uV (mono). Quoted image rejection of the HF band is greater than 60dB, and this figure also applies to the aircraft band; the figure for the FM band is greater than 50dB. IF rejection is quoted as greater than 80dB (both IF's), while the rated dynamic range for the HF band is greater than 95dB (20kHz spacing, SSB and 2.3kHz bandwidth).

Rated tuning frequency accuracy is better than +/-100Hz at 25°C, while the stability is quoted as +/-10ppm over the range 0 - 50°C. Rated maximum audio output into an external four ohm speaker is 2W, for less than 5% THD.

Trying it out

We tested the basic performance of a sample SW8 receiver on the bench, and it gave a good account of itself. The sensitivity figures were within spec for all bands; the AM sensitivity measured around 1.6uV over most of the HF band, with a minimum of 1uV around 8-9MHz and a maximum of 1.8uV at the top end. The SSB sensitivity had a broadly similar curve, with an average of around 0.48uV and a maximum of 0.5uV at the top end.

The aircraft band sensitivity was fairly even at just on the specified 4uV, while the FM band figures varied from about 3.5uV to 4uV, with the maximum at the low end. Measured selectivity in the three IF bandwidth settings was 6.0kHz, 4.2kHz and 2.0kHz, at the -6dB points. The frequency accuracy was well within the quoted figure of +/-100Hz, too.

To try the receiver out in a practical situation, we hooked it up to both a balanced HF dipole and a VHF discone — both with matching baluns. We also tried it with the inbuilt telescopic rod, which extends to a little over a metre. In all cases it gave good results in a typical suburban location, and was generally capable of producing 'clean' reception of signals even in relatively crowded and noisy band conditions.

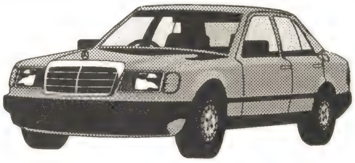
In fact one of the things which impressed us about the SW8 was that given a reasonable signal to work on, the audio quality was really good — and generally significantly better than the average communications or shortwave receiver. This was traditionally one of the Drake 'claims to fame' in the past, and it looks as if they haven't lost the touch...

We also found the SW8 very convenient to use. The tuning action is smooth and straightforward, allowing you to find the 'right' tuning point for SSB signals with minimum hassle. There are relatively few 'birdies' in the HF bands, and even without the RF attenuator in circuit the receiver is very tolerant of nearby 'big signals'. Changing the bandwidth and other settings is also quite straightforward, although the SW8 does have the habit of returning to its 'default' bandwidth settings when you toggle between modes.

Summarising, then, we would rate the Drake SW8 as a very nice receiver indeed for 'serious' general shortwave, aircraft band and AM/FM broadcast band reception. If you're after a solid, dependable receiver for this kind of work, you should certainly put it on your shortlist. At the quoted retail price of $1450 (including power supply), it also seems really good value for money.

Further information on the SW8 and its 'big brother' the R8 is available from the Australian agents for R.L. Drake, ZRV Electronics of Unit 10, 29 Peel Street, Eltham 3095; phone (03) 439 3389, or fax (03) 439 2483. ❖

AUTOMOTIVE ELECTRONICS



with **MAJOR AL YOUNGER** (USAR, Ret.)

A look at some 'bolt-ons'

This month I thought we'd take a look at *bolt-ons* — the auto industry's term for any item that can be added (bolted on) to a car. Most bolt-ons are in the 'do-it-yourself' category, with everything provided, and the electronic variety are often available in kit form. So let's sample what's available on the local market...

First of all, there are many types of *indicating devices* which can aid in warning you of coming faults or shortcomings. Often these are available in both digital and analog readout types, but I suggest you go for the analog. Why? Well, digital readouts can be dangerous to vehicle operations and your health. The brain requires a longer time to 'read' a digital device. Of course the one advertised on the TV that reads kilometres, is in the driver's normal vision path, and this helps. But digital electronic dashboards were tried in North America and were an expensive failure, besides being dangerous.

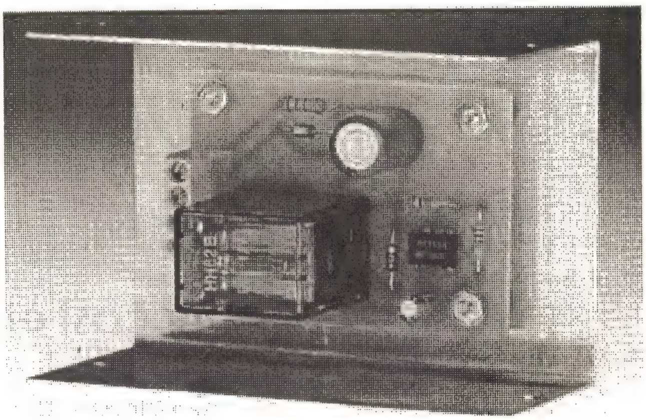
One company even had a 'touch screen' to control all the comfort functions, such as air conditioner and entertainment devices (radios, tapes, etc). You could always tell when the driver was changing something, as the car weaved down the highway. How many accidents did this cause? Detroit's not talking...

So, I prefer analog devices when operating a moving vehicle. You can respond much quicker by a simple lamp (LED) illuminating or a buzzer or sounding device. If an analog device has to be read or interpreted, that's also a no-no. Remember the KISS (keep it simple, stupid) principle.

An important rule of *safe* driving is to keep your eyes on the road. Can you imagine Peter Brock checking out a digital dash, as he enters a turn at Bathurst?

Car alarms

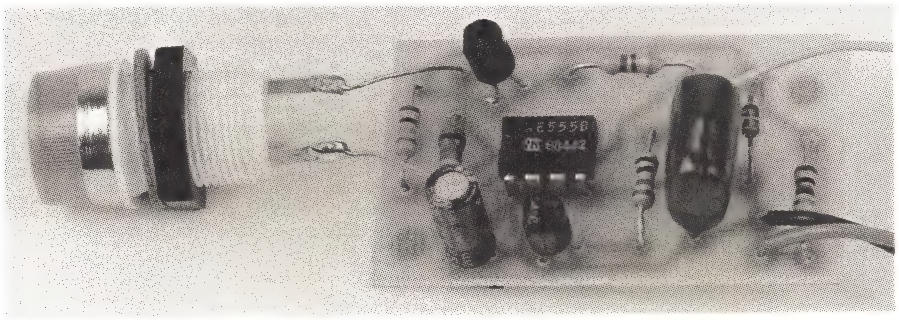
There's a large selection of car alarms available, many of them in kit form. The simplest and most effective is the Ignition Killer originally described in *EA*, February 1984. Most cars are stolen within 30 seconds, but with an ignition killer, the engine will not start. Add to the system the 'Dashboard Car Alarm Lamp Flasher' (*EA* February '86) and you'll most likely stop a thief from breaking your windscreen as well.



Another handy EA project available as a low cost kit, the Ignition Killer of February 1984. It prevents a thief from starting the car's engine...

Of course if your car's one of those models that are 'classics' on the stolen vehicle lists, no alarm will stop the professional. But at least you're likely to deter the amateurs and joy riders.

Now if you have the time and really want to 'go to town' with an alarm, you can use a combination of kits, at the high tech end. At a recent car show, I saw alarms that would 'talk' if someone came near the vehicle. To do this you could have your alarm trigger a voice recorder (*EA* May '94), which could say something like "Get away from my car, bludger" or "This car will self-destruct in five seconds" — I like that one. It can all be done, by using various kits that are available today, at many of the electronic stores advertising in ***EA***.



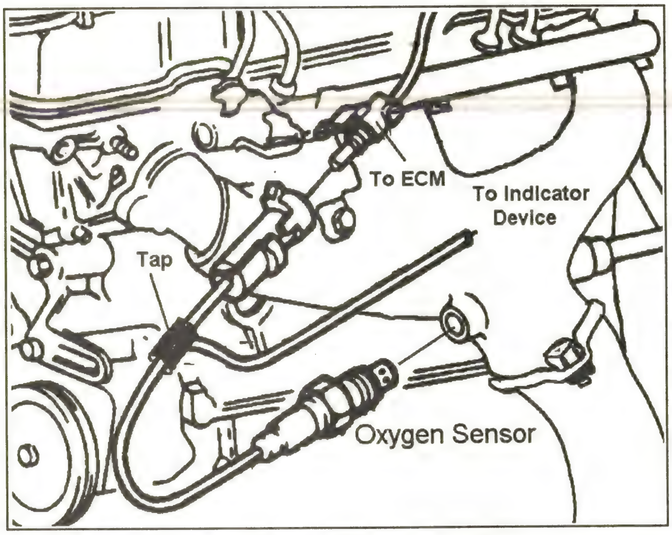
EA's 'Dashboard Lamp Flasher' of February 1986, a good thief deterrent — if you make sure the lamp is clearly visible from outside the car.

Battery indicator

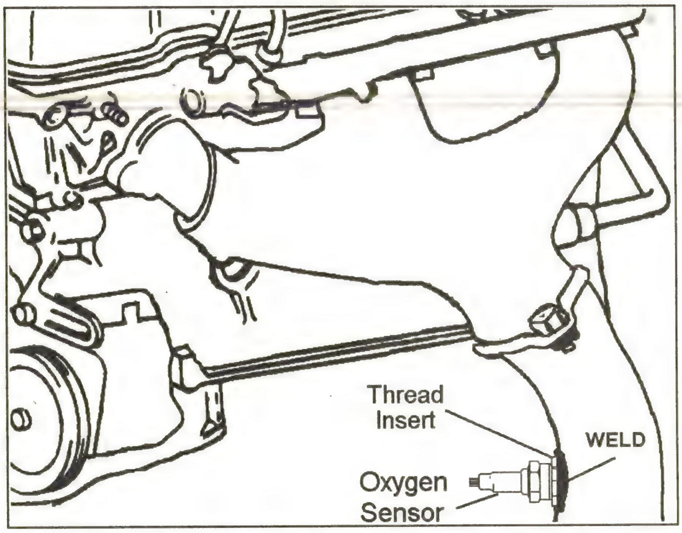
This is a simple three-LED device (*EA* May '92), which monitors battery voltage (charging) as correct, low or high. It should not take you long to recognise the colour sequence of this indicator. Super-easy to build and use, and a kit will cost you less than seven dollars.

Tachometer

The LED Tacho described in *ETI* (August '80) is ideal. You can change the



To add a monitoring device to a car already fitted with an O_2 sensor, a 'tap' is made in the cable running to the ECM.



On the other hand, to add a monitor to an older car, you'll have to mount a heated O_2 sensor on the exhaust pipe...

colours of the LEDs to suit your taste. You may consider using a LED bargraph instead of separate LEDs. The bargraph I used in my oxygen sensor article (*EA* February '94) allows changing the LED colours. A tacho is a worthwhile 'bolt-on', and when used correctly can prolong engine life.

Incidentally, the tacho kits available are not of autotech standards. A good digital tacho must have a resolution of at least 25rpm, since some factory idle specifications are within +/-25rpm. My own tacho has a high and low range. The low range covers from 0 to 2000rpm, +/-2rpm, and is used to monitor and adjust base idle setting — which is critical on most EFI (electronic fuel injection) systems.

Oxygen sensor

For those of you that have a car equipped with an O_2 sensor, there are several kits available for indicating circuits. The PCB for my own design (*EA* January '94) is available from RCS Radio, while a full kit for Peter Killin's EGO (Exhaust Gas Oxygen) Tester (*EA* February '94) is available from Jaycar, for less than $20. This is a worthwhile bolt-on, if you understand how the O_2 sensor operates. If not, just read my article or the one in the February '94 issue, for a full explanation.

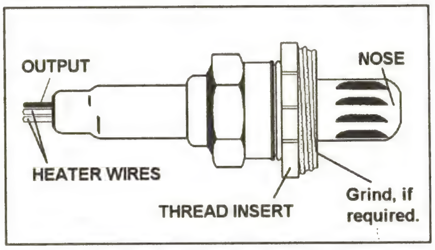
Monitoring the O_2 sensor output on an EFI car lets you know if the system's in good nick. The LEDs should be 'hunting' (switching) as the ECM (electronic control module) changes the AFR (air fuel ratio) from lean to rich, rich to lean, etc., to maintain the average AFR at 14.7:1. If the indicator does not show this switching, there's something wrong with your system.

Add-on O_2 sensor

I've received many enquiries about adding an O_2 sensor to your car, if it doesn't have one. Yes, it can be done. Here's one way to go, by using one of the monitors mentioned above and physically fitting a sensor to your exhaust pipe. It's not exactly 'bolt-on', because it does require welding.

Pick up an 'aftermarket' O_2 sensor, because they are usually the cheapest. It should be a heated one, such as the Tomco 11014. The two white wires are the heater leads, which should be **fused** and switched through the ignition. The black lead goes to the monitor circuit.

The next step is to install the sensor in your exhaust pipe. The sensor threads are 14mm pipe threads, the same as some spark plugs. So, we must find some way of getting threads in the exhaust pipe. Go to your friendly parts supplier and pick up a 14mm 'thread insert'. These are used in the automotive and industrial fields for fixing stripped threads. The most common one is for spark plugs which have been cross-threaded into aluminium heads. These inserts are often called 'head savers'.



To mount an aftermarket O_2 sensor in your exhaust pipe using a thread insert, the insert may need to be ground back to expose the vents in the 'nose' of the sensor.

The insert may have to be ground off at the inner end, to allow exposure of the sensor's nose.

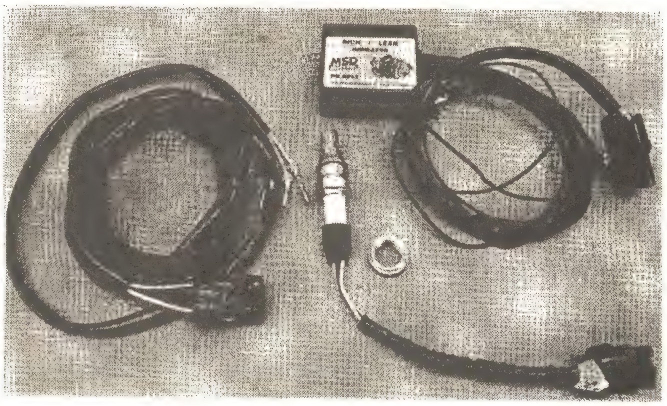
Then take your car to your friendly local auto repair or muffler shop, and have the technician cut a hole in the exhaust pipe and weld the insert in place. It should be placed in the steel exhaust pipe, NOT the cast iron section of the system. Make sure you remove the O_2 sensor before the welding takes place!

To make things easier, have everything ready to install. Have the O_2 sensor with its leads attached and ready to screw into place. When the technician finishes the welding, have him cool it off and then screw in the O_2 sensor — it should be firm, but not too tight. Check for exhaust leaks and you're on your way.

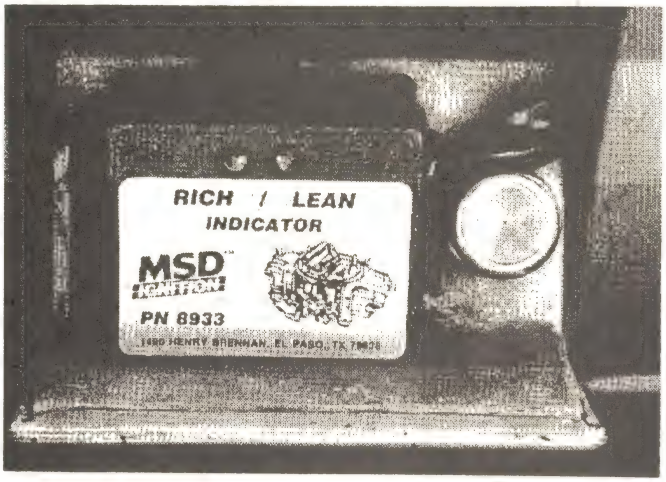
Now don't forget what you'll be reading: it's the O_2 content in the exhaust. A low reading equals *high* O_2 content (i.e., plenty of unused oxygen, so a *lean* mixture) and of course a high reading equals *low* O_2 content, signifying low residual oxygen content and hence a *rich* mixture. With a non-electronic system the monitor reading will only change as you change the fuel ingested by the engine — for more information read *EA* for February '94.

Aftermarket kit

If you are not into electronic kit building, you can purchase a complete built-up O_2 sensor/monitor package, manufactured by MSD/Autotronics Controls. You still have to use the services of a welder, but the thread insert is furnished for you. The MSD 'Rich/Lean Indicator' package (Part Number 8933) costs around $248 plus tax and may be purchased from your auto parts supplier. Contact Lynx Corp, the distributor, for



The complete MSD exhaust O2 or 'Rich/Lean' indicator pack, which includes both the sensor and the thread insert to mount it in the exhaust pipe.



The MSD Rich/Lean (O2) indicator pack's electronics can be mounted in an ash tray, with power taken from a cigarette lighter socket.

your nearest MSD dealer: phone (02) 747 3333 or fax (02) 747 3571.

General comments

Using fairly standard analog circuitry, you can easily monitor engine or car functions. The secret is not to muck about with the operations of the car's ECM. Within your warranty, bolt-ons raise many eyebrows and have been known to void the warranty. For instance, if you connect into the car's EFI sensors, it may effect the system operation. Even if it does not, in warranty you may be in trouble.

A few of the gadgets I have seen in other parts of the world may be of interest. One I like is a *back-up alarm*. We've started to see them on commercial vehicles, but we should be able to make our own. It's very simple: just have your back-up lights trigger a sounder (buzzer, etc), or an electronic 'beep-beep' circuit.

What about an electronic dashboard, but with *analog* readouts? A friend of mine saved me a lengthy construction project article on digital dashboards, from a magazine published in North America. He thought I would be interested in such a project, but I have already discussed the problems with the brain, reading digital displays, so my only interest was with the transducers (sensors) in the project. But making an analog electronic dash could be real fun, since most of the sensors are analog to begin with. Using a circuit with the LM3914 bar-graph display driver chip does the rest.

Source of sensors

An ideal place to pick up sensors is your friendly local car salvage yard. A busted engine can contain temperature and oil pressure sensors that may be used for other purposes. On a car's firewall or fender wells, you may find MAP (manifold absolute pressure), vacuum and barometric pressure sensors. Although some output frequency, many output from 0 - 5V DC.

These sensors are very accurate. The Ford MAP sensor will sense barometric pressure changes from a storm front, even set a fault code in the KAM (keep alive memory). Most vacuum sensors output about 4.8V at idle and down to 1V or less at WOT (wide open throttle).

A vacuum reading allows one to drive the car in the most economical manner. Some cars are equipped with a vacuum readout device. The higher the reading, the better the fuel economy. We used to call them 'motor minders', after a popular brand that was so named.

A good project for weather buffs, but not necessarily for the car, would be to make a barometer using an auto MAP sensor. It could also be used for an altimeter, to about 3000 metres (10,000 feet). Use a GM sensor, which outputs volts. Any GM/Holden shop manual will give the voltage readings at different altitudes.

Be careful!

An important point to remember when you're working on EFI vehicles is not to *short* any leads to earth (chassis). Also do not use the ECM's *reference* voltages (5V, 9V or 12V) to do any **work**, like powering a LED. Blowing the reference voltage source is common when uninformed people muck about with the ECM. As a rule, you only need one pop and the ECM is 'crook'.

Don't forget, too, that a shorted battery can put out over **1000 amps**. I have seen shorted spanners turn white hot. Don't let it happen to you!

That's about all for now, I think. If you wish to monitor more of your car system's key functions, some of the 'bolt-on' packs and electronic kits available can be a great help. ❖

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READER INFO NO. 19

SHORTWAVE LISTENING

with
Arthur Cushen, MBE

RNZI focus on South Pacific

Radio Australia's field of broadcasting is moving more to the Pacific in general and into Asia, while Radio New Zealand International now beams programmes to the South Pacific in up to 14 languages of the area. So the two international services from this area provide a wide degree of programme, although not on a competitive basis.

Early broadcasts from New Zealand were carried on tramsitters of the Post & Telegraph Department of the Dominion of NZ, and in 1947 used such calls and frequencies as ZL2 on 9540kHz, ZL3 on 11,780kHz and ZL4 on 15,280kHz. Previously out of band transmitters were also used to carry a news bulletin to forces in the South Pacific such as ZLN4 on 9530kHz in 1945, ZLT10 on 6150kHz in 1946 and LZT5 on 11,005kHz in 1947.

Radio New Zealand officially opened on shortwave on September 26, 1948, using two 7.5kW transmitters at Titahi Bay, near Wellington. The initial schedule was to the South Pacific 0600 - 0845 and the programme was repeated 0900 - 1145 to Australia. The balance of the broadcast was a relay of the NZBC domestic network.

In 1960 a special programme for shortwave listeners was introduced when Cleve Costello presented 'This Radio Age', and in 1962 the session was altered and became 'Arthur Cushen's DX World'. This continued to be broadcast monthly, later fortnightly until April 1976 when the government closed down RNZ. By September, world wide pressure from listeners resulted in the government reinstating the shortwave service.

In 1980 RNZ became the name of the domestic network and the shortwave service was then known as NZ Calling. In March 1982, the government withdrew the subsidy of $180,000 and the transmission reverted to a relay of the National programme of NZBC, with no external programmes of its own. In 1986, a Royal Commission on Broadcasting looked at various aspects of the future of the shortwave service and a proposal made for a new site at Rangitaiki.

The coup in Fiji forced the NZ Government to realise the inadequacy of their voice in the South Pacific and on January 24, 1990, a new 100kW Thompson transmitter was opened at a new site near Taupo which also coincided with the Commonwealth Games in Auckland. The cost was some $3M for the transmitter, aerials, other facilities and the microwave link to studios in Broadcasting House in Wellington. Recently the aerial systems have been improved and a new expansion has resulted in coverage now available in the 49 and 41 metre bands, which are used in the present schedule.

The new shortwave service is funded by the Ministry of Foreign Affairs, and only the technical facilities are provided by Radio New Zealand. Since then RNZI as it is now known has concentrated on 14 languages of the South Pacific, from Papua New Guinea across to Tahiti. Many of these are relayed by the local broadcasters in the South Pacific, while Radio Australia coverage has been more towards Papua New Guinea, Indonesia and into Asia — so that there is no clash of services.

The opening of RNZI resulted in reports of worldwide reception throughout the year, in particular from North America. In Europe during our winter, signals are also well received. The 'Mailbox' programme with Tony King was reintroduced with shortwave news from the writer and this continued every two weeks in three transmissions.

From February 7, 1994 Tony King retired as presenter of the programme and his place was taken by Myra Oh, a Fijian working in the South Pacific Services of RNZI.

The schedule effective up to October 2, when NZ moves to Daylight Time is: 1650 - 1849, 7125kHz Mon-Fri; 1850 - 2136, 11,735kHz Sun-Fri; 2137 - 0458, 15,115kHz daily; 0459 - 0758, 11,900kHz daily; 0759 - 1206, 6035kHz daily; and 1207 - 1649 6035kHz occasional. 6035kHz and 11,900kHz are tentative frequencies.

As well as special services to the Pacific, the balance of the programme is a relay of RNZ National radio. The address for reception reports is RNZI, PO Box 2092, Wellington NZ and return postage is appreciated. Mailbox is broadcast every two weeks and includes answers to letters from listeners and a DX contribution from the writer. Broadcasts are Monday 0430 on 15,115kHz; Thursday 0830 on 6035kHz and Friday 1930 on 11,735kHz. ◆

AROUND THE WORLD

ALASKA: KNLS Anchor Point has been heard in English from 0800 - 0900UTC on 9615kHz. Some Chinese announcements are included in the programme. The address for reception reports is: Radio KNLS, PO Box 473, Anchor Point, Alaska 99556, USA.

AUSTRIA: Vienna has two English broadcasts to Australasia 0830 - 0900, 1030 - 1100 on 15,450 and 17,870kHz. The station also uses the transmitters of Radio Canada International for a service to North America 0530 - 0600 on 6015kHz.

BELGIUM: Radio Flanders, Brussels has English to Australia 0630 - 0700 on 6015, 9925kHz; 2100 - 2130 on 5910kHz. Both of the broadcasts are daily and a programme for shortwave listeners called 'Radio World' is heard in the Monday transmission.

BOLIVIA: Radio Difisora Tropico, Trinidad has been heard on 4552kHz with typical local music at 1040UTC. Identification is heard at 1045 and at 1100 followed by news in Spanish for 15 minutes.

CANADA: RCI Montreal has broadcasts in English, which are heard in this area 0400 - 0429 on 11,925 and 15,275kHz; 0500 - 0529 Monday-Friday on 6050, 6150, 7295, 9760 and 17,840kHz; 2030 - 2129 on 13,650, 13,670, 15,325, 17, 820, 17,850 and 17,875kHz. Transmissions originate from Sackville, Skelton and Vienna.

INDONESIA: RRI Pontianak was heard on 3995kHz but suffered interference from Radio Moscow. They have now moved to 3915 and are heard well at 1530, but at 1600 the signal is blocked by BBC World Service from Singapore.

ISRAEL: The revised English schedule now that Israel is on daylight time is 0400 - 0415 on 9435, 11,605 and 17,545kHz; 1900 - 1930 on 9435, 11,603 and 11,675kHz.

JAPAN: Radio Japan's Regional Service to the South Pacific 0900 - 1000 in English is now on 15,270kHz, while the General Service is heard from 0500 - 0600UTC on 15,410 and 17,810kHz.

NORWAY: Oslo broadcasts in English on Sunday only, to New Zealand at 0500 - 0530 on 7165, 9560, 9590 and 11,865kHz and to Australia 1200 - 1230 on 17,860.

SWITZERLAND: The International Committee of the Red Cross uses the transmitters of Swiss Radio International and has made a frequency change for its monthly broadcast.

Transmissions are in many languages with English 0700 - 0730 and repeated 1300 - 1330 on 6165kHz. The next broadcast is scheduled for Sunday July 31 and August 28.

TAJIKISTAN: Dushanbe transmitters are now used by Radio Nederland for their broadcast to South East Asia 0030 - 0325UTC on 9860 and 12,025kHz. There is a repeat broadcast at 0930 - 1125 on 12,065 and 15,470kHz. The normal transmission from Radio Nederland via Bonaire is now 0730 - 0830 on 9630, 9720kHz; 0830 - 0930 on 9720kHz and 0930 - 1030 on 9720 and 9810kHz.

UKRAINE: Radio Ukraine International has been heard on 9685 at 0300 in English. They announce the other frequencies as 9860, 11,720, 15,195 and 17,605kHz. ◆

This item is contributed by Arthur Cushen, 212 Earn Street, Invercargill New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time and 12 hours behind NZ Standard Time.

Experimenting with Electronics

by PETER PHILLIPS

IR remote control circuits

Two of our designs this month are based on a three-pin, low cost infrared (IR) sensor IC. There's a basic infrared on-off switch and also a really simple (but effective) 'extender' for remote controls — which can also be used as a remote control tester. We also look briefly at the SL486 infrared preamplifier IC, and a simple extender circuit from a reader, using it.

Although infrared remote control systems are as common as dirt, they remain a mystery to many people. A reason is their inherent complexity — such as the dedicated encoding and decoding ICs, a keypad and all the other high-tech components that make up the system.

We are not going to show here how to build a complete infrared remote control system; that's way beyond the scope of this column. But we *are* going to build a simple IR remote controlled on-off switch, and examine two ways of making an IR remote control operate its equipment from another room.

Before getting into the circuits, let's briefly look at how an IR remote control system works.

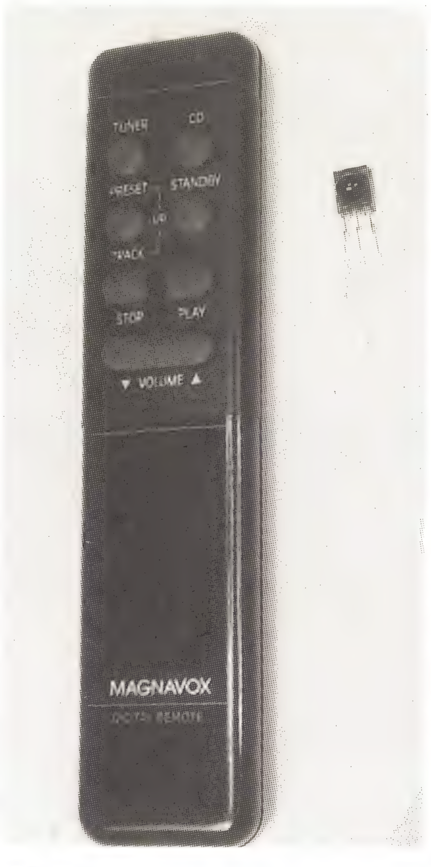
IR remote control

The basic block diagram of a typical infrared remote control system is shown in Fig.1. Pressing a key on the keypad causes the encoder to produce a burst of pulses that represents a digital code. Each key has its own code. When viewed on a 'scope, the pulses look rather like a barcode.

At the receiving end, the pulses are received by an IR sensor, amplified and filtered before being passed to the decoder. Depending on the received code, one of the outputs of the decoder is activated (asserted). Each output controls a function within the equipment, and the number of possible outputs depends on the number of bits in the code.

Of more interest here is the infrared light that 'carries' the coded information from the transmitter to the receiver. As the diagram shows, an infrared LED (light-emitting diode) is pulsed on and off by the encoder, and this 'pulsed' light is picked up by a light-sensitive diode in the receiver.

The problem facing designers of an IR remote control system is the ambient infrared light. Although we can't see IR light, it's everywhere, particularly in the day. So obviously an IR sensitive device is going to pick up the ambient IR light as well as that transmitted by an IR LED.



This IR remote control transmitter and IR sensor are key components for the circuit this month.

To get around this problem, the transmitted pulses are *modulated* by an ultrasonic carrier, usually at a frequency somewhere between 30kHz and 40kHz. The code is therefore sent as a series of high-frequency pulses, as shown in Fig.2.

The photodiode in the receiver picks up the modulated carrier, and the signal is amplified by a high-gain amplifier that's designed to respond only to the 30 - 40kHz carrier. The ambient light is not amplified, as it's a steady-state value.

A filter after the amplifier removes the carrier, leaving the original pulse train, which is then applied to the decoder. The end result is a remote control system that has little sensitivity to ambient IR light.

The question of standards has always plagued the electronics industry, and while there is a degree of standardisation between manufacturers of IR remote control systems, it's by no means universal. For instance, the carrier frequency is not fixed, nor is the number of bits in the code, the code format and so on. Fortunately there *is* sufficient standardisation to allow development of programmable 'universal' IR remote control transmitters, which 'learn' the codes from other transmitters.

Getting back to our circuits, you will notice they need an IR transmitter and an infrared optical sensor. These are shown in the lead photo. The transmitter can be any infrared remote control handpiece, or you can purchase the one shown in the photo for $8 from Oatley Electronics.

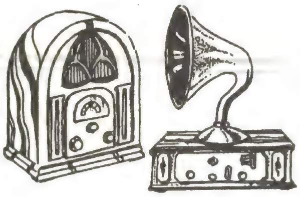
The sensor is an inexpensive device with the type number IS1U60. Those used in this article were supplied by Oatley Electronics, and an estimated cost is around $5. Although simple in appearance, this sensor is a very sophisticated and sensitive device...

The IS1U60

The infrared sensor, type IS1U60, contains an IR sensor, high-gain amplifier and a filter. The output is therefore a

Vintage Radio

by PETER LANKSHEAR



The saga of the Crystal Set

Recently I was taken to task because, in its six years, this 'Vintage Radio' column has not yet featured crystal sets. The point has been taken, and this month we cover some aspects of this classic and in its time, most important receiver.

The basic crystal receiver comprises only three components: an inductor, a diode and a headphone — although to be completely accurate, there are also two virtual capacitors formed by stray capacitance of the aerial and the headphone leads. It would be impossible to create a simpler receiver than the elementary crystal set, yet entire books have been written about it. What other type of receiver has remained basically unchanged for 80 years?

In the period from the advent of broadcasting to the arrival of the cheap transistor receiver, making crystal sets was one of the traditional childhood activities. There were several reasons for its popularity. Crystal sets were inexpensive, simple to make, cost nothing to run and what is more, they *worked*.

There is no receiver simpler than the basic crystal set, yet an endless series of circuit variations appeared in radio and hobby publications and were eagerly assimilated — previous models torn apart and the new variations tried. Many young experimenters got 'bitten with the radio virus' as a result, and went on to make radio their careers.

Like much electronics technology, the origins of research in the electrical characteristics of crystals go back to the 19th century. The earliest work of which I can find any record was by Ferdinand Braun in Germany during 1874, in what could be regarded as the first research into semiconductors. Braun reported that various combinations of metals with oxides or sulphides, with small contact areas, displayed unilateral electrical conduction characteristics.

As with many early discoveries, here was a solution waiting for a problem. Braun went on to other work, including cathode rays, and it was a further 25 years, in 1901, before he conducted experiments into the use of crystals for radio detection. He worked with galena (lead sulphide) and iron pyrites, but it was psilomelane, a mineral containing manganese, with a sensitivity equal to that of the electrolytic detector, that he considered showed the greatest promise. Braun reported his findings to Telefunken, but there seems to be no record

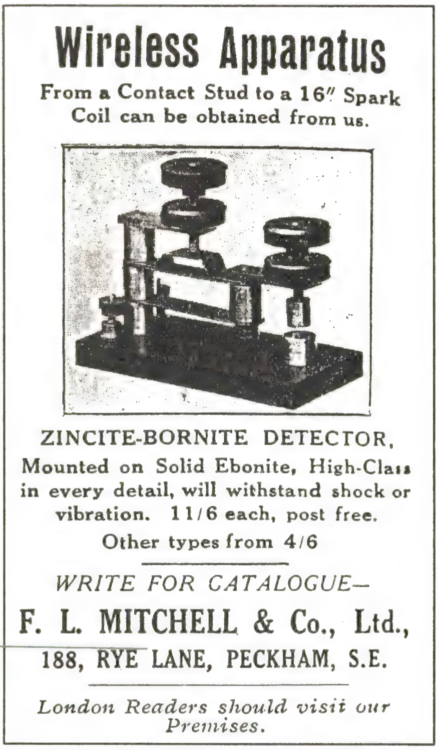


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Fig.1: A crystal detector advertised in the Marconi 'Yearbook of Wireless Telegraphy & Telephony' for 1914.

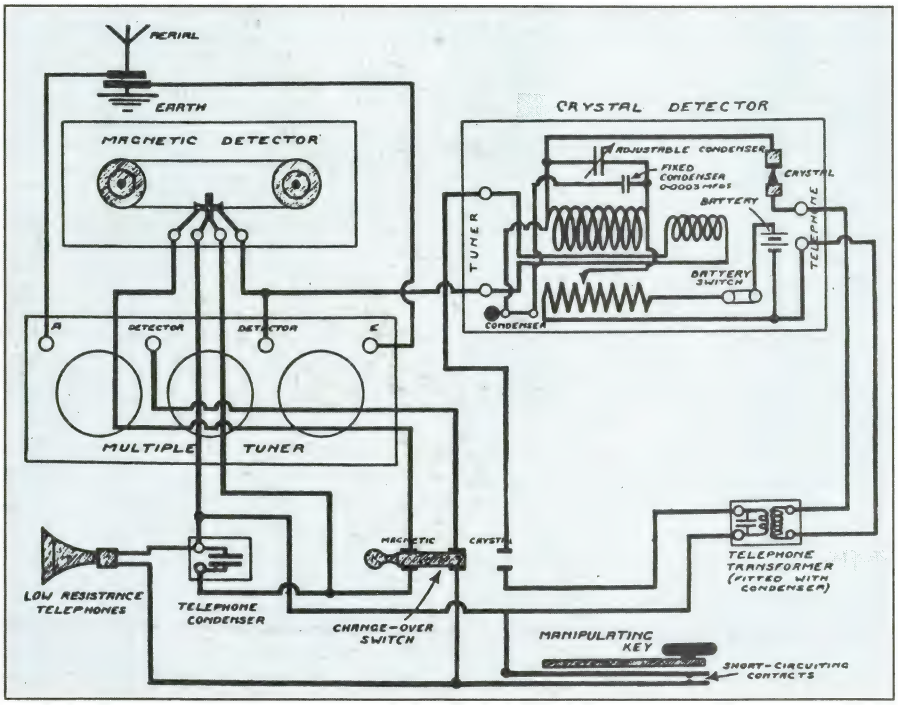

AERIAL
EARTH
MAGNETIC DETECTOR
CRYSTAL DETECTOR
ADJUSTABLE CONDENSER
FIXED CONDENSER 0·0003 MFDS
CRYSTAL
BATTERY
TUNER
TELEPHONE
BATTERY SWITCH
CONDENSER
A
DETECTOR
DETECTOR
E
MULTIPLE TUNER
MAGNETIC
CRYSTAL
LOW RESISTANCE TELEPHONES
TELEPHONE CONDENSER
CHANGE-OVER SWITCH
TELEPHONE TRANSFORMER (FITTED WITH CONDENSER)
MANIPULATING KEY
SHORT-CIRCUITING CONTACTS

Fig.2(a): The circuit of a 1915 shipboard Marconi receiver installation, providing the choice of a magnetic detector ('maggie') or a type 20 crystal set. Note the battery and rheostat for biasing the crystal.

sible to find an industry representative, or even a common point of view from the industry.

I have attended several so-called 'Electronics Industry' meetings, and I can assure you the opinions, and needs, are very wide ranging.

Regarding recognised training institutions, it is fair to say that TAFE has the support of most industries I've had contact with. There are other private trainers, and quite a few graduates from these institutions have done well in the industry. The usual path to a BOC is an Electronics Trades course, followed by a Post Trade course of 12 months duration. However, I've heard talk recently of discarding the BOC as a requirement to operate a TV transmitter.

You specifically ask for a correspondence course R.L., and TAFE runs these courses through its OTEN network. I suggest you call into the local TAFE college and ask for a contact name and phone number for OTEN.

However, as with any practically-based course, you will need to do a certain amount of hands-on work, possibly through a local college. I don't know the exact arrangements.

Incidentally, many readers might not be aware of how different TAFE courses have become in recent times. As a direct result of industry restructuring, there have been many changes made to trade, certificate and eventually, associate diploma courses. And these are the very courses many *EA* readers are interested in.

Basically, the change is the introduction of National Modules. A National Module is usually a 40-hour (can be more or less) learning package on a particular subject, or part of a subject. The content of each module is decided by TAFE and industry representatives from all states of Australia, and a document called a National Descriptor summarises the content of each module.

Each state then develops, from the descriptor, a teaching package for each module that suits local conditions, finances etc. However, the basic content and testing strategies must remain essentially the same, regardless of where it is being taught.

If you study and pass a particular module, you can then claim an exemption for that module in any learning institution, anywhere in Australia, for all other courses that use that module. That is, you only have to pass a module once in your life to be deemed competent in that module.

Assessment for each module is competency based. That is, you are assessed on your ability to meet prescribed learning outcomes, as listed in the descriptor. The assessment might be a written test, a practical test or a combination. However, there are no marks; you either pass or fail.

The National Modules are not only taught by TAFE, but sometimes by other accredited training providers. Therefore, if you intend undertaking a course in electronics, say an Electronic Trades course, make sure you are doing a course constructed with National Modules. Advanced Certificate courses are now being modularised, and it will eventually flow through to Engineering Associate Diploma courses.

So, R.L., even though the electronics industry is hard to identify, providing you undertake a training course based on National Modules, taught by an accredited training provider, no one in the industry can dispute your educational attainments.

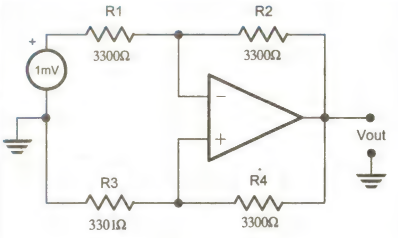


Fig.3

2TM goes to FM

Remember 2TM, the Tamworth country music radio station that has featured in the January and April 1994 editions? A reader has sent me a fax saying that this station has now converted to FM, somewhere around 92.7 to 93.7MHz. Apparently this has been the case since the beginning of the year. Thanks to N.F., of Stockton NSW.

This now raises the question of receiving distant FM transmissions, which is one without any easy answers. The usual solutions are a high multi-element antenna, and perhaps a masthead amplifier. We hope to include an article in either the July or August issues by Tom Moffat, on improving reception by coupling an external dipole to a receiver with a ferrite rod, but this may not be of much benefit at VHF.

Incidentally, another reader has advised me that an AM station with the same frequency as 2TM (when it was AM) is operating on the west coast of New Zealand. The output power is 2kW and its call sign is 3ZW. Apparently he receives 3ZW much better than 2TM, suggesting the need for a selective loop aerial.

What??

We are back to op-amps this month, with a question from Bryan Maher, author of *Op Amps Explained.*

Bryan's question is: What is the output voltage of the circuit in Fig.3? Assume that the op amp is ideal, that is, it has an infinite open-loop gain, an infinitely high input impedance and zero output impedance. Assume a +/-15V DC dual polarity power supply to the op-amp. Notice that R3 has a value of 3301 ohms.

Answer to June's What?

The answer seems to be that the published response charts for eye sensitivity to colour show the response in *daylight*, when the maximum sensitivity occurs at about 550nm. At night, when rod vision is predominate, the eye is more responsive to blue as the peak sensitivity of the eye shifts to about 510nm, where blue is about 500nm.

Then again, there might be a more pragmatic reason, such as the best colours having been taken by other services. Green would seem to be the best, but who would associate green with the police? ❖

EXPERIMENTING

Continued from page 89

the SL486 circuit worked as well on 6V as on 9V. The second circuit was fairly sensitive to supply voltage, and seemed best at around 5V or 6V.

4. A critical aspect of the second circuit (Fig.6) is the oscillator frequency. Tests confirmed most equipment required a frequency of around 30kHz, with some equipment being less sensitive to the carrier frequency.

Therefore, while the second circuit doesn't work with all equipment, it has the best sensitivity and therefore the best operating characteristics. It's possible that further research into the values of the supply voltage, carrier frequency and IR LED forward current would solve the few instances where the circuit didn't work.

But that's what experimenting is all about, and for the cost of around $6, you can build and test this circuit on your gear. If it doesn't work, try different values of supply voltage, carrier frequency, IR LED current, IR LED position and so on. If it still doesn't work, it has only cost you $6.

Happy experimenting! ❖

INFORMATION CENTRE

Inductance and RCDs

You might remember a letter in March '94 about inductive loads causing false triggering of an RCD (residual current detector). I suggested various other reasons for this, making the point that inductance is unlikely to be the cause. But it seems I might be wrong...

I always enjoy reading your Information Centre and feel I might be able to shed a little light on A.D.'s problem with residual current detectors, as described in the March issue.

Nuisance tripping when switching on inductive loads is a real problem and is quite random. Sometimes the circuit switches on with no problems, at other times it trips for no apparent reason. A check of the installation with a 500V insulation resistance tester will probably show a leakage resistance well over tens of megohms.

I think the reason lies in basic AC theory. When an inductive load is present in a circuit, the reactive component of the current lags the voltage by 90°. When the voltage is at maximum, the current is at zero. When the voltage is at zero, the current is at maximum.

An inductive load may be switched on at any point in the voltage waveform. If it happens to be switched on near zero voltage crossing, the current will rapidly rise to double the normal peak value. This has the effect of a decaying DC bias on the AC current waveform. I suggest it's this DC offset that drives the very small current transformer in the RCD into saturation, giving an output to the trip circuit. The attached printouts illustrate the point.

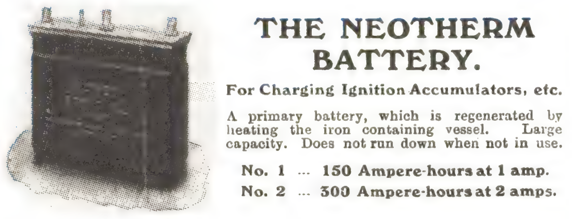
How can it be overcome? Possibly by designing an RCD with a larger current transformer, containing fair dinkum iron so it will not run into saturation. This would make the unit larger and more expensive, and therefore less attractive to the user.

Otherwise, as A.D. suggests, run a separate circuit for inductive loads that is not protected by an RCD. RCDs give very worthwhile protection to people using handheld appliances, so these circuits should be RCD protected. Another thought is to fit troublesome inductive loads with an electronic switch that turns on only near the maximum voltage. Whichever way you go, it will cost money! (K.V., Kallangur Qld.)

One of the printouts sent by K.V. is shown in Fig.1, where the dashed line shows a DC component for several cycles. Saturation by a DC component in a triac controlled transformer circuit is a big problem, so it's quite feasible for a DC component from an inductive load to cause a problem here.

As you say K.V., the solution is a toroid in the RCD with a larger core, which of course is up to the manufacturer. Otherwise, as our previous correspondent suggested, run a separate circuit for inductive loads.

Incidentally, a reader has reminded me that you can increase the sensitivity of a clamp meter by winding additional turns through the clamp. For example, two turns doubles the sensitivity, so you divide the reading by two; three turns, divide the reading by three. My thanks to D.H., of Annandale NSW.



THE NEOTHERM BATTERY.

For Charging Ignition Accumulators, etc.

A primary battery, which is regenerated by heating the iron containing vessel. Large capacity. Does not run down when not in use.

No. 1 ... 150 Ampere-hours at 1 amp.
No. 2 ... 300 Ampere-hours at 2 amps.

Fig.2

Neotherm battery

Now here's something I reckon few people will have heard about, including me:

Enclosed is a photocopy of an advertisement for the Neotherm Battery. I found it in a small book called The Motor Manual, produced by the staff of The Motor magazine in London in 1910.

Could you possibly comment on the Neotherm battery, and its principle of operation. It seems to me that the principle of heat equals electricity directly is an idea that ought to be rediscovered. (K.E., Henley Beach SA.)

I have quite a few texts on electricity dating back to the early 1930's, and none of these mention such a battery. I did find a full description of the Menotti cell (also a primary cell) which overcomes the problem of polarisation with copper sulphate. (Polarisation in a cell is the effect of gases forming around an electrode, increasing the internal resistance of the cell, and reducing its output voltage).

Another text, dated 1931, devotes four pages to the Air Cell Battery. This battery, produced by Eveready *'consists of two cells, assembled in a moulded hard-rubber container and permanently connected in series. Like the regular dry-cell, the Air Cell uses zinc and carbon electrodes. Unlike the dry cell, which uses a depolariser in the form of a paste to prevent hydrogen from forming on the carbon electrode, the new Air Cell uses an electrolyte solution in conjunction with a plate formed of a newly invented special grade of carbon which is highly porous to oxygen. This has the peculiar property of extracting oxygen from the unlimited supply of surrounding air which we breathe, and making it available inside the cell for its function as a depolariser to combine with the hydrogen on the carbon electrode to form water.'*

The output voltage of the Air Cell is 2.5V when new, falling to 2.0V when discharged. I wonder what happened to this rather interesting development!

The Neotherm battery is also described as a primary battery — i.e., it cannot be recharged. I think that perhaps the regular application of heat was needed to depolarise the battery. In other words, the Neotherm battery probably did not produce electricity from heat. The heat simply rejuvenated the battery. If anyone can throw more light on this subject, please let me know.

Learning electronics

I have responded several times to letters like the following, so there's obviously interest in the topic. First the enquiry...

I would like to do an electronics course which would allow me to service and install communications equipment and possibly do television servicing. I would then like to extend to a Broadcast Operators Certificate (BOC), if this still exists.

I have seen various advertisements offering correspondence courses. My question is: What teaching institutions do the electronics industry recognise? (R.L., Broken Hill NSW.)

I'll first address the question of what is the 'Electronics Industry'. Unlike most other industries, the electronics industry comprises many small to medium size repair and sales businesses, and only a few large manufacturing concerns. It is therefore not represented by a particular union (although the Electrical Trades Union seems to handle award matters in most large electronic industries) and is not as cohesive as, say the electrical industry. For this reason, it's often imposregulator so each transistor passes around 5A. The power dissipation with a DC supply of 20V is (20 - 13.8) x 5, or around 30W per device. For these figures, total power dissipation will be about 160W.

A conservative design would use six to eight transistors as the series pass elements, with a low value series resistor in the emitter circuit of each transistor to ensure the load current is equally shared by all transistors. A large, possibly fan cooled heatsink is essential.

Concerning projects for the Amiga computer, unfortunately no one on the magazine staff owns one. We occasionally include circuits suited to the Amiga in our 'Circuit and Design Ideas' section, and if anyone has developed an Amiga project they think other readers will want to build, let us know.

Component codes

The next letter asks a question I'm sure a few readers have pondered, at one time or another...

I have just purchased one of your books on filter circuits. It's just what I've been looking for, but I cannot find any of the ICs referred to in the book. I've tried the usual places, including Dick Smith Electronics, Jaycar and Altronics.

Can you tell me where I can purchase ICs type: NE5534, LF351, uA741, LM137000N and HA12017. (D.H., Rubyvale Qld.)

Manufacturers usually code ICs with the device number and their own identity code. For example, an NE555 from RCA is coded RC555, from National it's LM555 and so on. But does this mean that devices from different manufacturers with the same number are identical?

In theory, yes. In practice, not always. However it's unusual for a circuit to be so critical that you have to use a device from a specified manufacturer. So, D.H., you'll find many of the components you are after by simply looking for the number.

For instance, the 5534 op-amp is available from Jaycar as an LM5534 and as an NE5534 from DSE and Altronics. The uA741 is simply a Fairchild version of the 741, which is one of the most common of all op-amp ICs.

If you still cannot find some of the devices you need, and you're sure there's no readily available substitute, try Geoff Wood Electronics (phone 02 428 5198) or WES Components (02 797 9866). These firms often have hard to get ICs. Another Sydney supplier who might be able to help is Farnell Electronic Components at 72 Ferndell Street, Chester Hill, NSW 2162, phone (02) 645 8888.

Micronta circuit

The next writer is asking for help from the readership.

I have a Micronta multimeter analog type 22-203C, made in Korea for Tandy. Would you or any of your readers please be able to help me with a circuit diagram, a parts list giving component types and part numbers, an instruction manual. Please help! (Jon Pagst, Yacht 'Alyssa', c/o PO Gove 0880, NT.)

There are many brands of analog multimeters, although Micronta is a fairly well known one. Hopefully a reader might be able to help Jon.

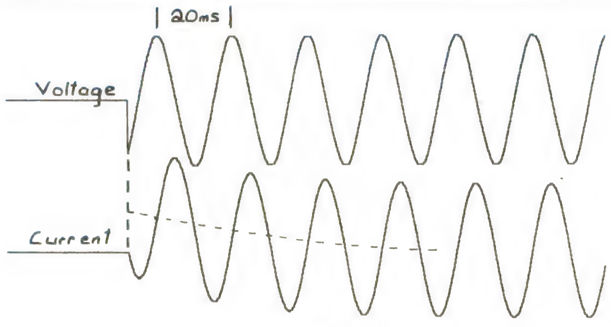


Fig.1

Exposure meter

Photography and electronics go almost hand in hand these days, and we get quite a few letters from readers who enjoy both hobbies.

I have been interested in photography for some time, and I finally summoned up the courage to try my hand at darkroom work. I am now addicted, and I am about to set up my own darkroom. However there is one small problem — no 240V mains. Our house is powered by 12V DC, so I have had to modify your April 1982 darkroom timer circuit to work from this voltage.

My main reason for writing is to ask if you have ever described an Exposure Meter for use with an enlarger. They are commercially available, but they cost around $200 or more. Also, I haven't seen an enlarger timer for some time. Perhaps this might be a suitable project for the magazine. (D.H., Beechwood NSW.)

Checking our project database shows two possible designs, both published by *ETI*. The only exposure meter described in *EA* is a Flash Exposure Meter in the January 1980 issue. The *ETI* projects are a Darkroom Exposure Meter in January 1985 and a Digital Exposure Meter in March 1984.

Regarding timers, the most recent timer project that should suit your needs is the Digital Photo Timer described in the December 1993 edition of *EA*. This timer is available as a kit from CTOAN Electronics, and is based around a microprocessor. It's simple to build and very versatile.

UV light source

I'm surprised we've not had more requests like this one...

Could you please tell me if there are any plans available for the construction of a UV light source for PCB development work. (B.H., Morley WA.)

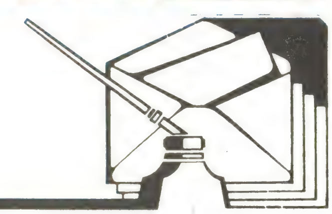
Although we've published articles on PCB making in the past, B.H., we have never actually described the construction of a UV light source. Such a device is relatively simple and mainly requires woodworking (or metalworking) skills rather than electronic knowledge.

A design I have used consists of a wooden box with four by 20W UV fluorescent tubes inside the box. The box is therefore about 600 x 300 x 300mm (L x W x D). The tubes are mounted about 150mm below a sheet of glass in the top of the box. A lid covered with sponge holds the PCB and artwork in place during exposure. It also seals the box to protect the user from the UV light. A typical exposure time with this box is around two or three minutes when exposing a PCB or UV sensitive film. A timer can be added to control the lights.

RS Components sell 8W (stock number 556-250) and 40W (559-990) UV tubes, as well as complete UV exposure units. A small UV box, fitted with two 8W UV tubes and a timer costs around $350 (555- 279), but the tubes are only $42.56 for two. You can probably build the rest. Rod Irving Electronics has 15W UV tubes (H28600) at $32.95 each. These were specified in an EPROM erasing unit described in *ETI* for June 1984.

Kalex, who specialise in hardware for PCB making, sell 8W, 15W, 20W UV tubes and also have UV light boxes priced from $250. Farnell Electronics also has UV exposure boxes, the cheapest (249-324) priced at $280.

Information centre



Conducted by Peter Phillips

The Neotherm battery, excessive fees and more

Reader enquiries this month range from a question about a battery I'm sure very few people have heard of, to a question about training institutions for electronics. And it seems an inductive load *can* cause a residual current detector (RCD) to false trip.

Without further ado, I'll open with an extract from a letter sent by a young reader. The rest of his letter is dealt with elsewhere in this column.

Regarding your 'Information Service' for readers, why does it cost $7.50 to get a photocopy of an article? Let's say an article takes five pages. That's 50c to $1 for the photocopies, 45c for a stamp, 50c for an envelope and minutes of your time. I wonder where the other $5 goes?

Don't forget that the reader also has to pay $2 for a money order and 45c for a stamp. Please re-evaluate your costing. And while you're at it, why does it take so long for my letters to be replied to? If I send to your competition, I get a reply within 10 days. (J.P., Teralba NSW.)

Fair questions J.P., so I'll explain. Photocopying does not take minutes of our time, unfortunately. The requested article first has to be found, the copies made and the original article returned to the filing system. The copies then have to be put into an addressed envelope, along with a typed reply. The package is then sent to another office for mailing. Total time can be up to 30 minutes per photocopy request, sometimes involving up to three people.

In fact, the only reason we offer a photocopy service at all is as a service to our readers. We make no money out of it, and probably even lose on the deal. To do it for less than $7.50 is just bad business.

Regarding letters, we acknowledge (where possible) all letters we receive. We usually send a form letter to let you know your letter has been received and what is being done about it. If you have paid $7.50, you will get a reply from a member of the technical staff, as soon as time permits.

Letters without the $7.50 fee are usually passed to this column, where they are used if we believe they raise points which are of interest to other readers. If your letter is used in this column, a reply with an answer to your query is sent. If the letter is not used, though, you probably won't get a further reply...

We have to impose these rules and charges for sound business reasons, J.P., and I think most people see them as quite reasonable. We do have a magazine to produce, and as we're not a public service we do need to charge for personal replies to technical queries. Unless you include the $7.50 fee, I'm afraid you'll have to take pot luck about a reply.

Having got that off my chest, here's the rest of J.P.'s letter...

More bass!

Congratulations on a great magazine. I was wondering if you could help me with a problem to do with positioning speakers in a room. I have built an 80W per channel amplifier (ETI-1430) and I am using a pair of home made speakers (a commercial design) that have a 12" 60W woofer, a 4" 40W mid range and two 3" 20W tweeters. The system gives me the right level of power I want in my small room (loud, and very loud if I want to show off!)

But I am having a problem getting enough bass. I don't mean normal bass, I mean headache-inducing bass. I have always put it down to my small room size (see attached diagram) but I have found that if I stand on my bed, right against the wall opposite the speakers, I get more than enough bass to satisfy my sub-200Hz hungry ears.

Since my parents weren't too keen on attaching a hanging chair from the ceiling, I have to turn to you for more ideas. Also, what is the maximum continuous temperature rating for a 2N3055 power transistor? I am developing some really high power 13.8V power supplies and am using 2N3055's as I got 30 of them at a good price. How many would you expect a 40A supply to need?

Finally, please try and include the Amiga range of computers in your articles and columns, as they really are superior to the IBM compatibles in most ways, except for the user base. (J.P., Teralba NSW.)

Unfortunately you forgot to include your diagram, J.P. However, here's a few ideas for you. Bass response from a loudspeaker can be improved by placing the speakers so the walls and floor reflect sound that otherwise escapes.

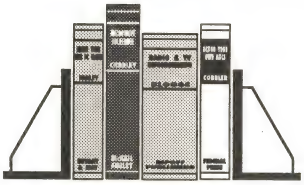
For instance, you'll find placing the speakers on the floor gives more bass than mounting them on a shelf. A corner gives even more sound reflection. I don't know how your speakers are mounted, so all I can suggested is floor mounted, corner positions for best results — and the right kind of speaker enclosure, of course.

I once listened to a system that had four bass speakers installed in the lounge I was sitting on. These speakers were in addition to the usual speaker boxes, and I can assure you the bass was most effective. So maybe you could attach a couple of 12" woofers to the underside of your bed!

However, be assured room size is not your problem. You only have to hear a top-line, high-power car audio system to be convinced of that.

The maximum junction temperature for a 2N3055 is 200°C. The absolute maximum collector current is 15A and the power dissipation is 115W. For a 40A supply, I would design the series

NEW BOOKS



Satellite reference

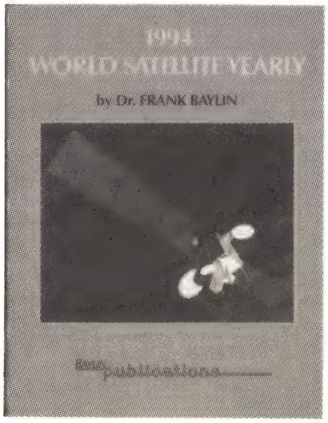
1994 WORLD SATELLITE YEARLY, by Dr Frank Baylin. Second Edition, Baylin Publications 1994. Soft covers, 276 x 214mm, 656 pages. ISBN 0-917893-20-4. RRP $140.

It's becoming harder and harder to keep up with the developments in satellite communications, because they're coming at an ever-increasing rate. There are more and more birds being put 'up there' around the earth, plus a stream of improvements to microwave technology, compression and encryption systems, and expansion of services available in one area or another.

Dr Frank Baylin is an acknowledged world authority on this subject, and has co-authored a number of books dealing with various aspects of it. In this now-updated volume he has produced a truly massive reference work, with an enormous amount of current information on (a) the technical side of modern satellite communications (including encryption and MPEG digital compression); (b) the transponder programming on the world's current geostationary satellites; (c) comprehensive reference information on all of these satellites; and (d) a full listing of virtually all of the companies involved worldwide in satellite programming, spacecraft manufacture, satellite system operation, reception equipment manufacturers, and industry publications.

It all seems to be presented concisely, accurately and accessibly, too. In short, a book that should be found invaluable by anyone working seriously in this area — or anyone else who wants a really up-to-date insight on the state of the satellite communications art, especially with regard to satellite TV.

The review copy came from AV-COMM, of 198 Condamine Street, Balgowlah 2093. (J.R.)



Micro design guide

MICROPROCESSOR ARCHITECTURES AND SYSTEMS, by Steve Heath. Published by Butterworth-Heinemann, 1993. Soft cover, 150 x 230mm, 288 pages. ISBN 0-7506-1628-8. RRP $45.95.

How would you decide whether a circuit design or computer architecture should be based around a CISC (complex instruction set) or a RISC (reduced instruction set) processor? What about a DSP (digital signal processor) instead?

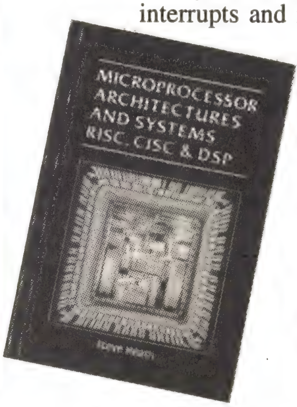
This book is mainly about the Motorola family of processors, and the author is cited as the 'processor technology specialist for Motorola'. You may know him as the author of *VMEbus User's Handbook*. The book is aimed at engineers and managers who need to understand the new microprocessor architectures and systems, to make informed decisions about them.

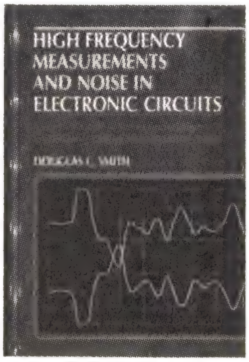
If the book was *only* for engineers, it would probably be written in technospeak that others can't understand. But because the target audience includes people like managers, the writing style is decidedly less technical, even friendly.

The author starts by looking at 8-bit microprocessors, then progresses to the 32-bit devices. Motorola RISC devices are then explained, followed by a chapter on DSP, concentrating on the DSP56000 family of devices. Memory management, interrupts and multiprocessing concepts are explained and there's a chapter on future developments.

The book is very readable, informative and even hard to put down in some parts. In fact, anyone interested in computer technology will find this book an excellent way to keep up to date.

The review copy came from Butterworth-Heinemann, PO Box 345, North Ryde 2113. (P.P.)




HIGH FREQUENCY MEASUREMENTS AND NOISE IN ELECTRONIC CIRCUITS
DOUGLAS C. SMITH

HF measurements

HIGH FREQUENCY MEASUREMENTS AND NOISE IN ELECTRONIC CIRCUITS, by Douglas C. Smith. Published by Van Nostrand Reinhold, 1993. Hard covers, 236 x 157mm, 231 pages. ISBN 0-442-00636-5. RRP $109.95.

Making accurate measurements of signals (and noise) is hard enough at low frequencies, but gets harder as you move up the spectrum. Unless you have a good grasp of the various complicating factors which come into play at higher frequencies, and know how to 'tame' them, your measurements will be at best dubious and at worst meaningless. So that's the aim of this book: to explain the various phenomena which occur at higher frequencies, and provide a worthwhile reference on techniques to overcome them.

Author Douglas Smith is an experienced HF design engineer, having worked at AT&T's Bell Laboratories for over 23 years. He has 13 patents for HF circuit configurations, and also conducts seminars on HF measurement techniques. So he's well qualified to write a book on the subject — and it's good that he has, because there's not much else available in readily accessible form.

Basically, it seems a very down to earth and informative volume, with a great deal of practical material on making valid and accurate measurements. It should make a valuable reference for anyone working in the area of measurements at higher frequencies. Hopefully when it's reprinted, though, the publisher will fix the embarrassing spelling mistake on its cover spine.

The review copy came from distributor Thomas Nelson Australia, 102 Dodds Street, South Melbourne 3205. (J.R.) ❖

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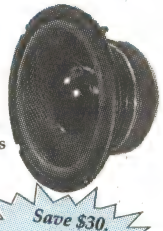

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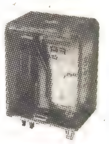

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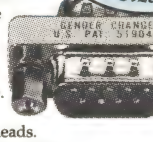

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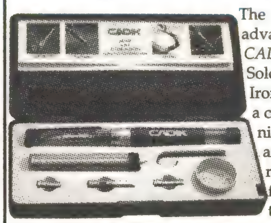

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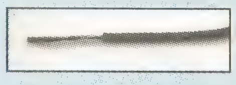

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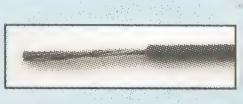

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Ugly is Only Skin Deep!

Stony Broke Speakers by REDBACK

As featured in SC Magazine June '94. This speaker kit is a bit like the Volkswagon; not too pretty to look at but performs superbly. Well that's the same as the Stony Broke speakers; pretty ugly but sounds sensational. Frankly, the reproduction from these speakers must be heard to be believed. They sound simply amazing. Ideal for bookshelf speakers, extension speakers or speakers for personal walkman type systems. Comes supplied in kit form. The kit for each speaker consists of two large jiffy boxes, one C 0629 30 Watt driver, one C 3010 tweeter, crossover, innerbond wadding, port tube, spring loaded terminals, 6 metres of cable, all fixing screws etc. In fact all you will need is a tube of silicon or similar to seal the 2 boxes together. The main speaker holes have been machined, all you will have to do is drill the mounting holes for the speakers. No special tools are required. Basically all you will need is a screwdriver, soldering iron, drill with 3mm drill bit, cutters etc. Even though these are a low cost kit, there has been a considerable amount of engineering to achieve the resultant sound! The main speaker driver complimented with the tuned enclosure exhibits quite amazing bottom end for a speaker this size.

Stony Broke Looks Ugly Sounds Sensational!

"These have no right to sound as good as they do!"
Leo Simpson, Silicon Chip Magazine.

C 3200 Only $89.95 per pair

Professional Series Instrument Cases

As a result of a massive scoop purchase, Altronics can now offer these fantastic cases to you at rock bottom prices!

Lightweight and Compact

As used in many EA and SC kit projects and by many major manufactures Australia wide, these instrument cases are moulded from ABS plastic and feature internal mounting posts, PCB guide rails and ventilation slots. Attractive textured finish, with removable front and rear panels. Complete with rubber feet

Dimensions - 250W x 190D x 80H mm

H 0482 Light grey

H 0483 Black

Normally $20.85 ea, **This Month Only $14.50 each**

Give Your Project that Extra Professional Finish!

300 Watt Inverter

This nifty inverter converts 12 Volts DC to 240 Volts AC. Includes an on/off switch and a light & heavy load switch with metered output. Works well with most electrical equipment. Includes heavy duty battery leads to connect directly to your battery.

M 8120 NORMALLY $249.00

This Month Only $199.00

Fantastic for Farming, Boating, Camping etc.

Aviation Headset

1000's Sold Across Australia-Includes 2 Year Warranty!

It was not to long ago when spending $450.00 on an Aviation Headset was not uncommon. Altronics changed all that when we released our C 9070 Aviation Headset for $199.00. Now with the edition of the flexible boom unit and helicopter version (fitted with a Nato plug) our headsets have gone from strength to strength. Add to this enhanced microphone, improved lead shielding and headband comfort these headsets must be the best value for money in Australia!

C 9070 Standard Model **$199.00**

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This Month Receive a FREE Carry Case Valued at $19.95

3.75 Digit Dual Display Auto Ranging Digital Multimeter

NEW

One of the Best Meters We've Ever Stocked!

This fantastic auto-ranging meter features minimum and maximum functions. Memorise an input for later reference. Continuity and diode check. Volts AC with frequency. Capacitance meter. Relative sampling displays either % or actual value difference of the current input compared to a memorised input. Transistor check for both NPN and PNP. Auto power off. Frequency test function. Stop watch. Large 16mm 3.75 digit display with bargraph.

Please call us or a full specification sheet.

Q 1045 $179.00

With 2 Digital Plus 1 Bar Graph Displays!

19" Rack Shelving

Do you have equipment that is not rack mountable. If so you need some of our super strong rack shelves. Super strong and superb value. All shelves are black power coated for a long lasting finish.

Now available - extra deep shelves for multi-play carousel CD players etc.

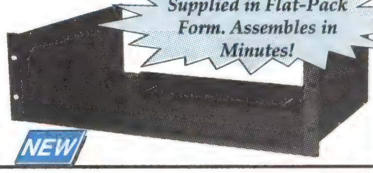
H 5352 2 Unit 340mm Deep **$49.95**

H 5353 3 Unit 340mm Deep **$54.95**

H 5363 3 Unit 400mm Deep **$64.95**

H 5354 4 Unit 340mm Deep **$59.95**

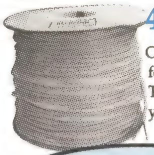
H 5364 4 Unit 400mm Deep **$69.95**



Supplied in Flat-Pack Form. Assembles in Minutes!

NEW

4 Core Security Cable Bargain



Our supplier has sent us a shipment of this cable with a slight imperfection - sometimes the outer sheath is welded to the inner insulation. This doesn't mean the cable can't be used. The conductors are fine, you just need to strip the insulation off carefully. Each conductor is 14 strands of 0.2mm. Complete 200m roll only at this price.

Save Over a Massive 55% Sorry Not Available from Altronic Resellers.

WA0356 Normally $140.00

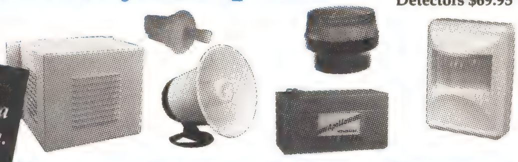
This Month Only $60

Hurry Limited Quantity. Only ~~30, 17~~ 9 Rolls Left!

Quality Alarm Systems as Used by Security Companies

Protect Your Home or Business from Intruders with One of these 'State of the Art' Burglar Alarm Systems

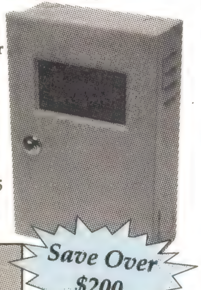
Both Systems Include Everything you Need for a Complete Security System. Even Cable!



Additional S 5302 PIR Movement Detectors $69.95

Deluxe Security System - Package 1

Everything you require for your home or office, even the cable! This package includes are deluxe S 5485 4 sector alarm panel. It features a user selectable 4 digit pin number allowing you to arm and disarm the alarm via the inbuilt digital keypad. 4 independent sectors accept almost any type of sensor (Normally Open and Normally Closed). Any sector can be individually isolated, (e.g. when at home you may want to turn on perimeter sensors, allowing movement inside). Includes a 24 hour panic and tamper sector. Alarm pre-warning reminds you to disarm on entry. Constructed in sturdy steel case with lock. Includes easy to follow installation instructions.



Package 1 Includes:

• S 5485 Alarm Panel • S 5065 1.2Ah Battery Backup • M 9027 Plug Pack • C 2015 External Siren • S 5460 Siren Cover • S 5445 Strobe • 1 x S 5302 PIR Movement Detector • S 5160 Tamper Switch • 1 x S 5153 Reed Switch • W 0303 200m 6 Core Cable

Normal Value of $657.90

This Month Only $450

Includes FREE 200m Roll of 6 Core Cable!

Save Over $200

Economy Security System - Package 2

This package includes the S 5480 3 sector alarm panel. It features an inbuilt keyswitch allowing you to arm and disarm the alarm. 3 independent sectors accept almost any type of sensor (Normally Open and Normally Closed). Includes a 24 hour panic and tamper sector. Constructed in sturdy steel case with lock. Includes easy to follow installation instructions.

Package 2 Includes:

• S 5480 Alarm Panel • S 5065 1.2Ah Battery Backup • M 9027 Plug Pack • C 2015 External Siren • S 5460 Siren Cover • S 5445 Strobe • 1 x S 5302 PIR Movement Detector • S 5160 Tamper Switch • 1 x S 5153 Reed Switch • W 0302 200m 4 Core Cable

Normal Value of $477.90

This Month Only $350

Includes FREE 200m Roll of 4 Core Cable!

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Regards Jack O'Donnell

Simple Driver Kit For Servo Motors

NEW

(See SC May '94) If you have ever wanted to experiment with servo motors but not known where to start, then this kit is for you. Servo motors are used in remote controlled cars, planes, remote mirrors etc. The article explains servos and how they are driven. The kit can be used to either test or direct control servos where a radio link is not required. It is a simple circuit to construct with minimal components.

K 6050 $16.45

Digital Storage C.R.O. Adaptor for P.C.'s Kit

LEVEL
RANGE
TRIG
SAMPLE
AC
DC
STORE
READ
RESET
START
POWER
ALTRONICS K 2805
DSO ADAPTOR

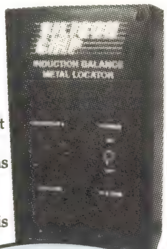
(See EA Jan '93) This great kit enables a P.C. user to capture a waveform and zoom in to segments of interest then save them to disc. The unit has 32K of storage memory and a sampling rate of over 600K samples per second. Input level of up to 2.5 Volt. Full sampling rate between 15K s/s to over 600K s/s. Input impedance of 1M ohm.

K 2805 Normally $63.50

This Month Only $55

K 2806 PC 5.25" Disk Software to Suit
K 2807 PC 3.5" Disk Software to Suit **$19.95**

Induction Balance Metal Detector Kit



(See SC May '94) What a great kit. This is a simple to build metal detector. It is suitable for wet & dry ground, includes adjustments to eliminate ground effects, has a sensitivity control and audible indicator. It can detect a small metal objects such as a coin at a distance of about 20cm. Please note this kit is supplied in short form. i.e. does not include PVC piping (standard electrical or plumbing pipe available from hardware stores) nor the plastic plate for the coils.

Find Lost Jewellry, Coins etc!

NEW

K 1250 $59.95

Megger Meter Kit

(See EA May '89) This design of an electronic meg-ohm meter features a dual voltage of 500 and 1000V with a large scale meter. It can resolve resistance from 1M to 200M ohm which is ideal for insulation testing *A must for checking earth leakage etc.*

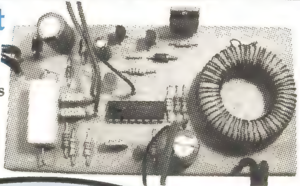
Over 1000 Sold!

K 2555 NORMALLY $79.00

This Month Only $75.00

ALTRONICS 1994
Retail Catalogue
If you haven't received yours call us on 1-800 999 007 for your free copy!

Nicad Fast Charger Kit



(See SC May '94) This kit will allow you to charge your nicads in a very short time. 50 minutes for 600Ah 'AA' and about 100 Minutes for 1.2 AH 'C' & 'D' cells. It can be powered from your car battery, or any other 12V DC source. Can be configured to charge 2 or 4 batteries at a time. Includes a built-in timer circuit to prevent over charging and utilises a switching controller to create a high efficiency charge.

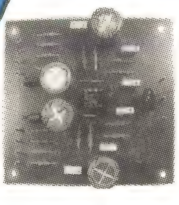
K 1665 $49.95

Charge up to 4 AA Nicads in Less than 1 Hour! Ideal for Remote Controlled Car Enthusiasts etc.

NEW

Universal Pre-Amp Kit

NEW



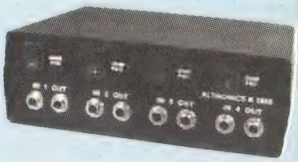
(See SC April 1994) Do you want to play records on your new stereo system but your system doesn't have phono inputs? Or boost your microphone to a higher output level. This is possible with the latest low-noise universal preamplifier. The K 5512 pre-amps offers three main configurations:- Phono, tape and microphone. All parts are supplied for all three. Its size kept small so to easily fix into existing equipment. The required power supply is ±15 volts which could be obtained from the amplifier voltage rails.

K 5512 $14.95

Calling All Musicians

Check out these professional looking but easy to build DI Boxes. DI Boxes enable you to run long lengths of cable from a microphone, guitar, or any unbalanced equipment to balanced input mixers or amplifiers, with virtually no induced noise. It does this by converting unbalanced lines to balanced lines.

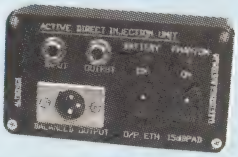
Quad DI Box Kit



(See EA June '91) The K 5555 allows you to use four separate instruments or microphones. The output of the DI boxes are XLR sockets. This unit also has a 20dB pad switch so you can use a wide variety of different impedance inputs.

K 5555 $79.95

The Single DI Box Kit



(See EA Oct '87) This single DI box is made for rough treatment. The full metal jacket ensures no interference and extends it's life. With professionally printed front panel, your friends wont believe you built it yourself. This DI box has the flexibility of running on a 9V battery or phantom power. It also has a 15dB pad and a unique earthing system.

K 5550 $55.00

Colour TV Pattern Generator Kit

Why Pay $$$ More for an Equivalent Commercial Model??

COLOUR
TV PATTERN
GENERATOR

(See SC Nov '91) If you repair TV's or monitors you must have one of these. One of the most important pieces of test equipment for TV service is a test pattern generator. With its seven different test patterns including • Checkerboard • White raster • Crosshatch • Red raster • Dot • Colour bars • Greyscale. It will enable you to pin point faults saving time and money. As in commercial models this unit also features colour bars and grey scales.

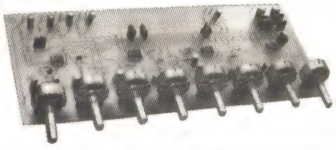
Makes Servicing and Aligning TV Sets Simple. Absolutely Essential for the Serious Serviceperson

K 2710 $115.00

4 Channel Mixer and Preamp Kit

(See SC Jan '92) This unit features separate bass, midrange and treble controls, very low noise and distortion, separate input level controls plus an output level. Ideal for use with most musical instruments from keyboards to guitars to tape decks and microphones.

Specifications
Distortion:............................less than 0.0075%
Graphic Equaliser:........Bass: ±14dB @ 100Hz
Midrange: ....±11dB @ 1kHz
Treble: ....±11dB @ 10kHz
Frequency Response:....18Hz - 35kHz (±3dB)



The kit includes PC board, potentiometers, input sockets and all specified components. Requires ±15V power supply.

K 5535 $49.95

FREECALL 1-800 999 007 PERTH (09) 328 1599

between 880nm and 940nm, depending on its characteristics.

An IR LED can be dark red, light blue, or even clear in appearance. You should not be able to see any light output from it, unless you have an IR night viewer. The output power is directly proportional to the forward current, and is typically around 15mW at a forward current of 100mA.

A conventional LED requires 10 or 20mA to operate, so an IR LED requires nearly 10 times the current of a conventional LED. For a 1/10 duty cycle, an IR LED can be operated at 200mA, assuming a maximum pulse width of 0.1ms. The forward voltage across an IR LED is between 1.5 and 2V, similar to a conventional LED. The reverse voltage is usually 5V, again as for a conventional LED.

An IR photodiode has a peak sensitivity in the IR region (880 to 940nm). The photodiode is operated with a reverse bias, and the reverse current depends on the incident light on the PN junction of the diode.

The ratio of change in reverse current to the change in light intensity is a measure of the gain of the device. Because a photodiode has a relatively small gain, a very high-gain amplifier is needed. Prior to IC versions, these were typically a four-stage, transistor amplifier built on a tiny PCB, shielded in a metal case.

IR extender uses

Returning to the two IR extenders, as is usual in this column, both circuits have been extensively tested. To put the bottom line first, neither circuit is a winner in all regards.

My test was simple: whether or not the extender could operate with every remote controlled appliance I own. The circuit using the SL486 was able to, but with some difficulty. The other circuit was 90% successful.

The main problem with the SL486 version was a lack of sensitivity. In some cases the position of the handheld transmitter relative to the IR photodiode was critical, and the operating range was very limited. It's likely that all designs using this IC would have the same problem. As well, this circuit produces noise that lights the IR LED in short, erratic bursts. While this has no effect on the remote controlled equipment, it is taking unnecessary current from the battery.

The alternative circuit (Fig.6) has no problem with sensitivity, and is responsive to signals bounced of the wall or ceiling as well as directly transmitted signals. At no time did it suffer from overload, even when the transmitter was held next to the sensor.

However, I was unable to make it work every appliance. Still, it had a 90% success rate, and further investigation would probably solve the final 10% of cases. During experimenting to try and solve the problems of both circuits, I found several interesting things:

1. Fitting the IR LED to an RCA plug, with an RCA socket at the end of the leads from the PCB, allowed a conventional LED, also fitted to an RCA socket, to be used to confirm the circuit was working. That is, unplug the IR LED and replace it with the conventional LED. The conventional LED showed a pulsing light output with all the remote control transmitters I tested the system with. So, if you want a cheap but effective remote control tester, simply replace the IR LED with a conventional LED!
2. The IR LED of both circuits had to be placed fairly close to the VCR or other appliance to be controlled — in some cases at a distance of around 50mm or so. In other cases, the appliance would respond with the IR LED up to a metre away.
3. The supply voltage varied the characteristics of both circuits, and I found

Continued on page 97

PARTS LIST

Circuit 1 (Fig.3)

Resistors

All 1/4W, 5%

R1	10k
R2,3	100k
R4	4.7k

Capacitors

C1	0.1uF ceramic
C2	10uF 16V RBLL electrolytic or tantalum

Semiconductors

D1,2	1N914 signal diode
D3	1N4004 power diode
Q1	BC548 (or equiv) NPN transistor
IC1	IS1U60 IR sensor (available from Oatley Electronics
IC2	4093 CMOS quad Schmitt NAND
IC3	4013 CMOS dual D flipflop

Miscellaneous

12V relay (or similar); DC power supply or battery (5V to 6V) and battery clip; strip board or matrix board; 2 x 14-pin IC sockets; hookup wire to suit.

Circuit 2 (Fig.4)

Resistors

All 1/4W, 5%

R1,3	82
R2,4	10k

Capacitors

C1,2	22uF 16V electrolytic
C3	33nF monolithic
C4	47nF monolithic
C5	150nF (0.15uF) monolithic
C6	15nF monolithic

Semiconductors

Q1	BC639 NPN transistor
Q2	BC640 PNP transistor
D1	LT536 (or equiv) IR photodiode
LED1	5mm IR LED
IC1	SL486 IR preamplifier

Miscellaneous

Strip board or matrix board; 16-pin IC socket; 6V or 9V battery and battery clip; hookup wire; twin cable for LED, length to suit.

Circuit 3 (Fig.6)

Resistors

All 1/4W, 5%

R1	47
R2,3	10k
R4,5	1k
R6	15k
RV1	10k pot

Capacitors

C1,4	0.1uF ceramic or monolithic
C2	15nF polyester or monolithic
C3	1nF polyester

Semiconductors

Q1	BC557 NPN transistor
LED1	5mm IR LED
IC1	IS1U60 IR sensor
IC2	555 timer IC

Miscellaneous

Strip board or matrix board; 8-pin IC socket; 6V battery pack and battery clip; hookup wire; twin cable for LED to suit.

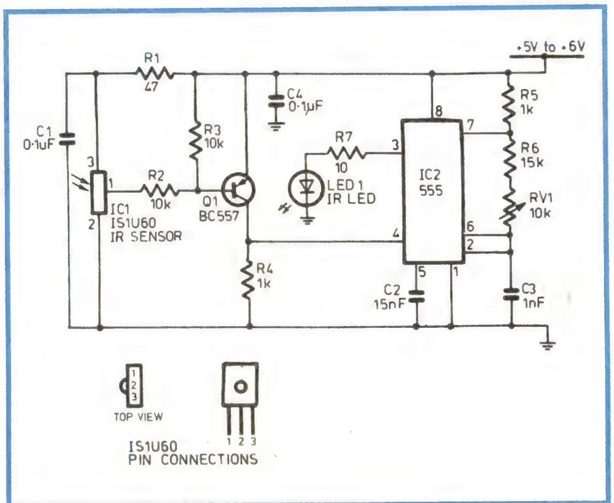


Fig.6: Another way of extending the output of an IR remote control transmitter. The signal is received, amplified and demodulated by IC1, inverted by Q1 and the carrier is reinserted by IC2. It may not work with all IR remote control systems.

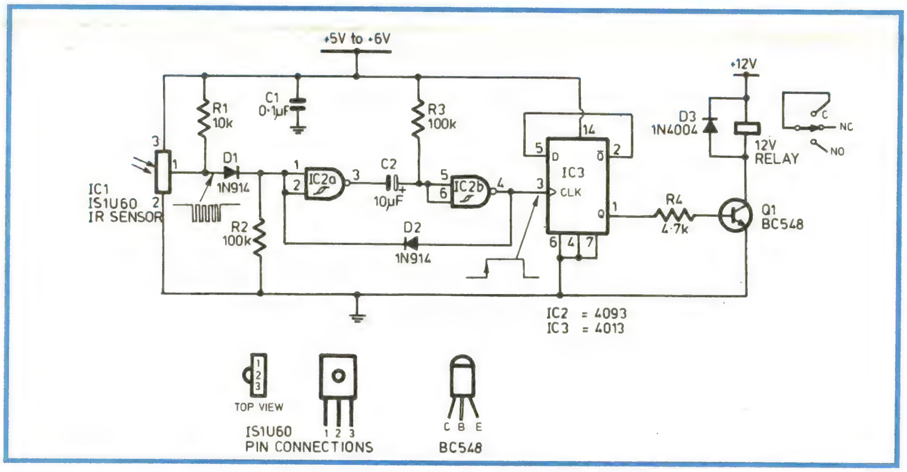

+5V to +6V
R1 10k
C1 0·1µF
R3 100k
+12V
D3 1N4004
12V RELAY
C
NC
NO
IC1 IS1U60 IR SENSOR
D1 1N914
IC2a
C2 10µF
IC2b
IC3
CLK
R4 4·7k
Q1 BC548
R2 100k
D2 1N914
IC2 = 4093
IC3 = 4013
TOP VIEW
IS1U60 PIN CONNECTIONS
C B E
BC548

Fig.3: An IR remote controlled switch, where IC1 receives, amplifies and demodulates the signal. IC2 is a one second timer and IC3 toggle with each received signal. The relay output stage is a suggestion only.

could be used to operate a mains-rated relay that in turn controls a 240V appliance. You could substitute the mechanical relay with a solid state relay, and operate a 240V light or other appliance within the specifications of the solid state relay.

IR remote extender

The second application is one that quite a few people will find useful. Called a remote control 'extender', an IR sensor picks up the signal from an IR remote control transmitter and the signal is re-transmitted via a IR LED connected to the circuit, but mounted near the remote controlled appliance. The advantage is that the appliance can be in another room, or on another floor of the house. It might sound simple, but not so in practice.

A traditional way to do this is with the SL486 IR preamplifier IC. I've included a simple circuit using this IC, sent to me by Martin Klein from Wollongong. This circuit is shown in Fig.4.

The output of the IR transmitter is received by the photodiode D1. From there, the IC does the rest, producing a replica of the modulated signal at pin 9. The circuit around the SL486 is from the manufacturer's application notes, and Martin has added a simple driver circuit for the IR LED.

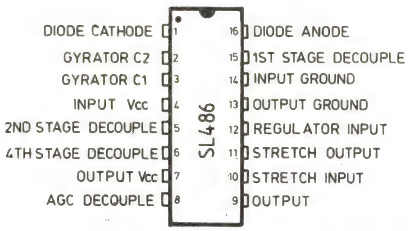

DIODE CATHODE 1
GYRATOR C2 2
GYRATOR C1 3
INPUT Vcc 4
2ND STAGE DECOUPLE 5
4TH STAGE DECOUPLE 6
OUTPUT Vcc 7
AGC DECOUPLE 8
SL486
16 DIODE ANODE
15 1ST STAGE DECOUPLE
14 INPUT GROUND
13 OUTPUT GROUND
12 REGULATOR INPUT
11 STRETCH OUTPUT
10 STRETCH INPUT
9 OUTPUT

Fig.5: The pinouts of the SL486 IR preamplifier IC.

The IR LED is driven directly from the supply by Q2, and Q1 drives Q2. A modification could be to use a smaller transistor for Q1, such as a BC547. The pinouts of the SL486 are shown in Fig.5. I'll discuss the merits and otherwise of this circuit after describing the circuit in Fig.6.

Simple IR extender

There have been a number of designs over the years for a remote control extender. Some of these circuits are quite complex, as they need to accommodate the wide range of IR remote control systems. Problems such as overload and low sensitivity are typical, and the final design is quite often a 'team of race horses', when, for many remote controls, a 'donkey' might do the same job.

While I wouldn't describe the circuit in Fig.6 as having the attributes of a donkey, it is certainly simple. The same IR sensor as already described is used to receive the IR transmission. Because the polarity of the transmitted data has to be retained, the output of IC1 is inverted by Q1.

However, remember that the transmitted signal is a modulated carrier, while the output of IC1 is the original data, less its carrier. Therefore, we need to reinsert the carrier. This is done with IC2, a 555 timer connected as an astable multivibrator (oscillator).

The oscillator frequency is set by timing components R5, R6, RV1 and C3. Resistor R5 is purposely small compared to the series resistance of R6 and RV1, to keep the output waveform's mark- space ratio almost equal. The IR LED is driven directly from the output of the 555.

The oscillator is switched on and off by the signal from Q1, via the connection from the collector of Q1 to pin 4 (reset) of IC1. When the voltage at the collector of Q1 is high, the oscillator operates. When this voltage is low, the 555 is in reset mode, and its output (pin 3) is held low. Therefore the output signal is the original modulated carrier as received from the IR transmitter.

Notice the supply decoupling to IC1, with components R1 and C1. Additional spike suppression is provided by C4, as the current pulses to the IR LED are quite large. Before discussing the performance of these circuits, first a brief look at IR LEDs and IR photodiodes.

IR LEDs and diodes

There are several important characteristics about an IR LED: its peak spectral wavelength, its radiant power and its forward current. Ideally, you should match the wavelength of the LED to that of the IR sensor. Typically, an IR LED outputs a wavelength somewhere

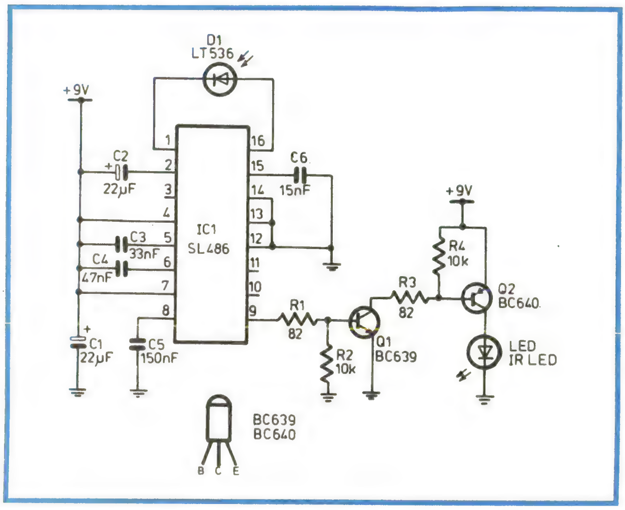
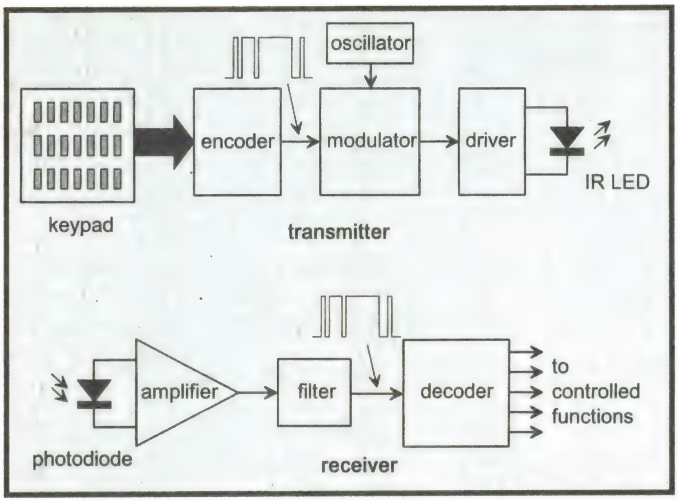

D1 LT536
+9V
C2 22µF
C6 15nF
C3 33nF
C4 47nF
IC1 SL486
C1 22µF
C5 150nF
R1 82
R2 10k
Q1 BC639
R3 82
R4 10k
Q2 BC640
LED IR LED
BC639 BC640
B C E

Fig.4: Based on the IR preamplifier IC, type SL486, this circuit receives the signal of an IR transmitter and reproduces the signal via the IR LED, driven by Q1 and Q2. It has a relatively low sensitivity.



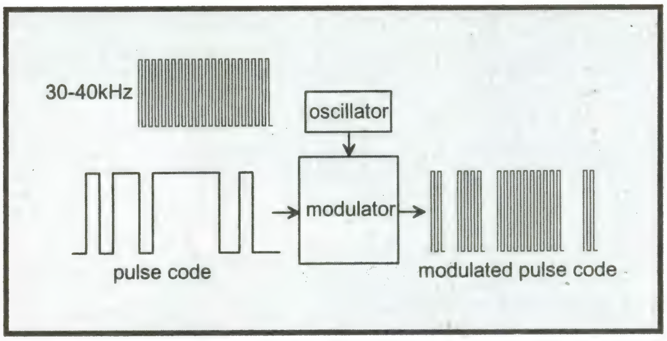


Fig.2 (above): The keycode for each transmitter key is modulated with a 30 - 40kHz carrier before transmission.

Fig.1 (left): The block diagram of a typical IR remote controle system.

digital signal ready to be applied to a digital or an analog circuit. In other words, this device does all the hard work. All we have to do is use it.

If you want to experiment with this device, connect it to a 5V DC supply, (+ to pin 3, - to pin 2). Then connect an oscilloscope to pin 1, and view the signal while pressing a key on an IR transmitter. You will see the unmodulated (but inverted) pulse train representing the data code for that key. The data code therefore has to be inverted before use, either with a transistor or a logic gate.

Unfortunately I don't have any data on the device, but experimenting with it proves that it needs a decoupled DC supply if the integrity of the data is important. I have operated the device up to 9V, and it requires about 3mA at 5V.

It is also quite forgiving, and despite my best efforts, I so far haven't destroyed any during experimenting. However, until I realised the importance of a decoupled and spike-free supply, the device was behaving as if it was faulty, producing either wrong, or no data at its output. A 0.1uF capacitor across the 5V supply fixed the problem, and I've since had no further difficulties in using the device. Now to the first circuit...

Remote-controlled switch

This circuit is shown in Fig.3. It contains the IR sensor (IC1), a timer (monostable) around IC2, a toggle flipflop (IC3) and a driver circuit for a 12V relay. The output pulse at IC1 triggers the timer, which in turn clocks the flipflop.

The timer produces a single pulse when there's an output pulse train from the sensor. Without the timer, it's virtually impossible to get reliable and consistent toggling of the flipflop, even with RC feedback around the flipflop.

The output at pin 1 of the IR sensor is normally high, and produces a pulse output when the sensor receives a transmission. This signal is coupled to IC2a via isolating diode D1. The inputs of IC2a are therefore held high, making the output at pin 3 a low. Timing capacitor C1 charges via R3, eventually pulling the inputs of IC2b high and sending its output low. The circuit is now primed, ready for a pulse.

When the output of the sensor pulses low, the inputs to IC2a are pulled low by R2, and the output of IC2a switches high, discharging C2 as both sides of C2 are at +5V.

At the next low to high transition from the sensor, the output of IC2a switches low, which is coupled via C2 to the inputs of IC2b. The output of IC2b now goes high, holding the inputs at IC2a high via D2.

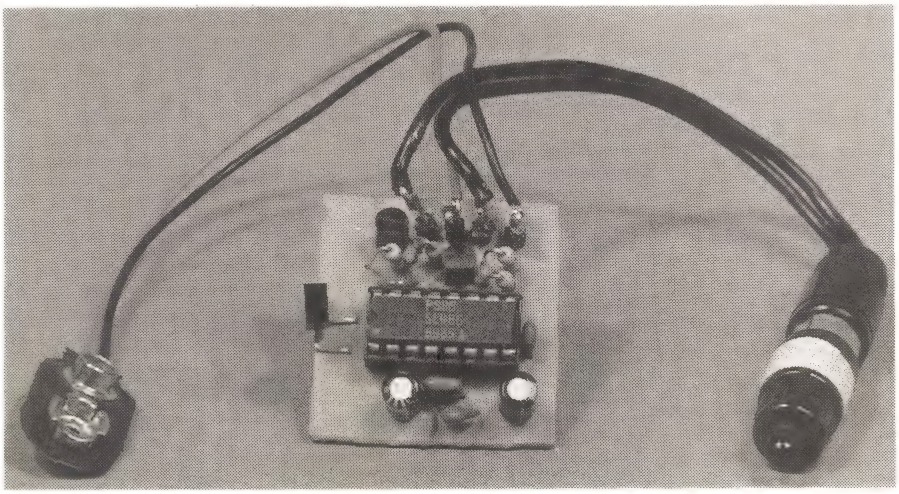
As a result, the output of IC2a stays at a low, and C2 starts charging through R3. When the voltage at the inputs of IC2b is a logic 1, its output goes low, allowing the inputs of IC2a to return to a low, sending the output of IC2a high. The circuit has now returned to its normal state, waiting for another pulse.

The D flipflop (IC3) is toggled on the positive edge of the pulse from IC2b, because of the feedback between the Q bar output and the D input. When the Q output of IC3 is high, transistor Q1 is switched on, via R4. This operates the relay, which in turn switches the device being controlled. Diode D3 clips the back EMF caused by the relay coil when the transistor switches off.

Using the switch

With the remote control transmitter shown in the lead photo, I found the switch operated reliably over a range of four or five metres. It even worked reliably from a reflected signal, where the transmitter output was bounced off a wall. It is quite stable and doesn't respond to electrical noise or transients. There are many applications for this circuit, limited mainly by the device switching the load.

As shown, the circuit can only operate low voltage loads. However, the relay



This is the IR remote control extender built by contributor Martin Klein. The PCB measures 33 x 30mm.

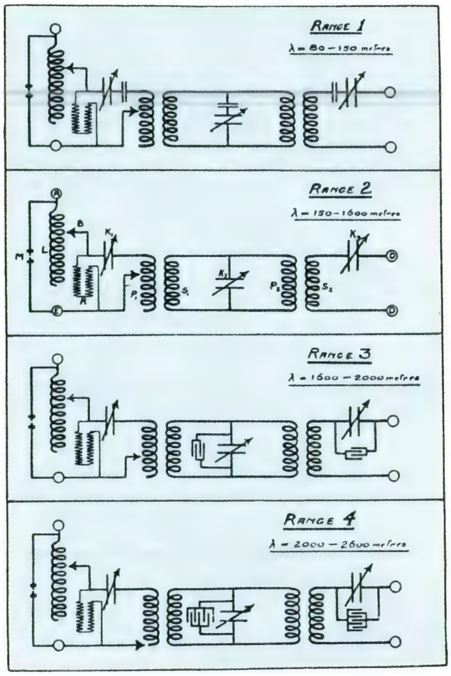


Fig.2(b): The various configurations of the versatile Marconi multiple tuner — much more complex than the domestic crystal sets of a decade later.

of that company or anyone else making practical application of his work.

The noted Indian scientist Sir Jagadis Chunder Bose, also in 1901, patented a detector of electromagnetic radiations, including Hertzian waves, which used a pair of galena crystals in contact. Bose considered that his detector worked as a variable resistance self-resetting coherer, but no further development seems to have followed.

Various detectors

Meanwhile, radio communication had developed into a commercial enterprise depending for reception on magnetic and electrolytic detectors, and coherers. Fleming's diodes, an adaptation of the 1884 patented Edison Effect lamp, were used by the Marconi Company as detectors from 1905.

The first practical application of a crystal as a detector has been credited to one of Lee De Forest's employees, a retired army general, H.H. Dunwoody. This was in 1906, the same year that De Forest himself first experimented with the triode valve.

Dunwoody had been experimenting with silicon carbide, or carborundum, which is made by heating a mixture of carbon and silica with an electric arc, and whose crystals approach diamond in hardness. He developed his detector to the point where the crystal could be clamped between steel electrodes, creating an extremely rugged and stable device; he found too that a polarising battery increased sensitivity considerably. By applying a bias voltage, the forward conduction point of the crystal was brought nearer to zero voltage. We see this same characteristic today in the forward voltage drop of silicon diodes.

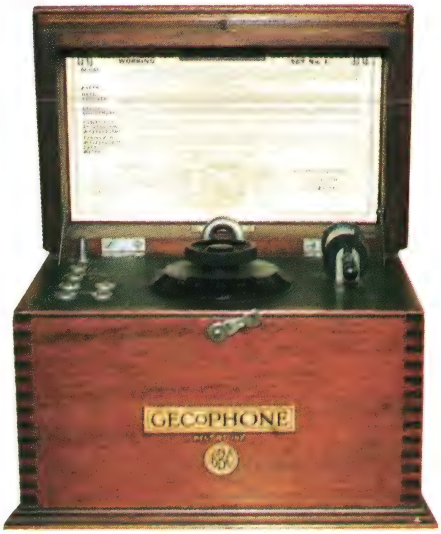


Fig.3: The British GEC variometer tuned Gecophone crystal set No1 of 1922, in a dovetailed mahogany case. Many sets of this era were similar in appearance to scientific instruments.

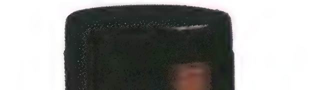


Fig.5: This 1924 novelty model, known as 'Uncle Tom', was made of Staffordshire china with the coil wound around the top hat.

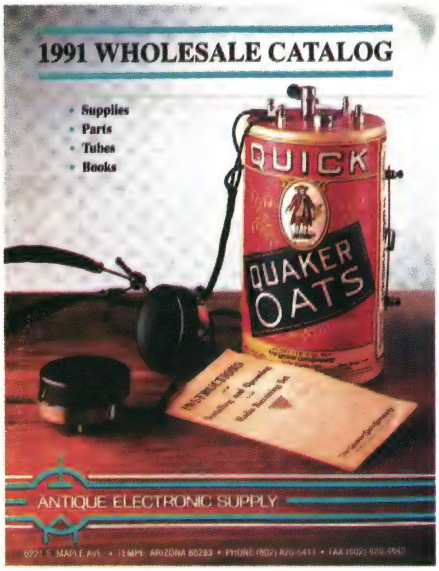


Fig.4: In 1919, US firm Quaker Oats offered this novel crystal radio, based on one of its cardboard oats cartons, for $1 plus two carton labels. By 1921, they had issued 250,000 sets. It was featured on the cover of Antique Electronic Supply's 1991 catalog, reproduced here.

Carborundum's success seems to have encouraged widespread research into crystal rectification, and in the period up to World War I a large variety of examples appeared. The more popular detectors incorporated molybdenite, galena, bornite, zincite, iron sulphide and tellurium. Some of these depended on metallic contact, whereas others used two different crystals in contact.

Some combinations were sold under trade names. These included the Perikon (chalcopyrites and zincite), Pyron (iron pyrites and silicon) and Bronc Cell (tellurium and graphite). Fig.1 illustrates a detector assembly using a zincite/bornite combination.

Often, these crystal detector assemblies were switchable. One gets the impression that there was a suspicion of reliability about crystals. It was common to mount two or more crystals in a turret, so that rapid changes could be made. In other cases, the tuner could be switched to either a magnetic detector or a crystal. A complete 1915 shipboard receiver circuit with this feature is shown in Fig.2.

Rather than rectifying more or less evenly over their entire surface, a few crystals were found to have sensitive spots that worked best when touched lightly with a piece of fine wire. This piece of wire came, of course, to be called a 'catswhisker' and one of the most sensitive crystals was a piece of galena, a common lead ore. One source of high grade crystals was the American town in Northwestern Illinois actually called Galena, where at one time, a thriving mail order business was carried on with radio enthusiasts.

Unlike carborundum, the galena crystal had the advantage of not requiring a biasing voltage to increase its sensitivity. Biasing added the complication of a battery and rheostat, and the operator having to remember to switch the current off after use.

The modern semiconductor diode is a direct descendent of these detectors, and the point contact germanium diode can be seen through a magnifying glass to be fundamentally a catswhisker in contact with a tiny piece of crystal.

Unsuitable at sea

Despite its good performance with weak signals, the galena crystal was not popular in marine service. As anyone who has 'tickled' a crystal will know, a slight bump is sufficient to dislodge the catswhisker; obviously, on a ship in a storm or with gunfire, this fragility would be hopeless.

Another weakness of the galena crystal is that it can be paralysed by strong nearby transmissions and atmospherics.

However, its simplicity and relative sensitivity made the galena crystal popular with amateurs, who were quite prepared to fiddle with catswhiskers, forever looking for more sensitive spots. When broadcasting commenced in the early 1920's, the galena crystal receiver played a significant part, especially in areas within a few miles of a transmitter.

The galena crystal did not have the monopoly in home receivers, though. Some proprietary crystal assemblies, such as the popular Red Diamond, used other crystal combinations and were somewhat more stable.

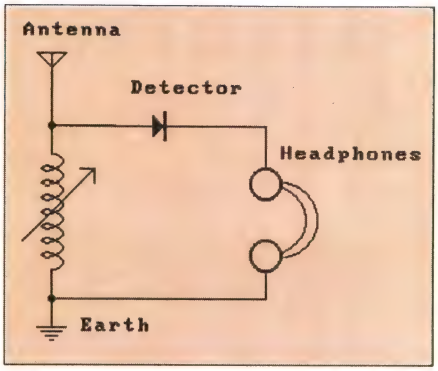


Fig.6: The fundamental circuit used in the five crystal sets illustrated. Although as simple as you could get, its weakness is lack of selectivity due to heavy damping of the tuned circuit.

A crystal set's performance is vitally dependent on its tuning system. The complex Marconi tuner in Fig.2 is capable of superior results, but would have been quite out of the question for a domestic receiver. It required considerable operational skill and the cost would have been quite prohibitive. In fact, in the heyday of the crystal set, the listener who could have afforded a Marconi tuner or similar would have been able to buy a valve receiver anyway.

Affordable radios

Manufacture of crystal sets for radio listeners boomed in the early and mid 1920's, especially in England. The book *Vintage Crystal Sets 1922-1927* by Gordon Bussey lists more than 200 different models and their makers.

The remarkable popularity of the crystal set in England was due to two factors. One was the proximity of a large number of listeners to a transmitter; the other was economic. Wages in Britain were low, and a crystal set was all that many could afford. Furthermore, anyone with a small degree of skill could make one.

The situation was different here and in America. Income was higher, and a fair percentage of the community was remote from transmitters. Even so, both commercially made and homebuilt crystal sets were popular, a remarkable American example being the Quaker Oats promotional model featured in Fig.4. Locally, firms like Emmco and Radiokes manufactured components to meet the needs of enthusiasts, and *Wireless Weekly* provided them with plenty of projects.

Only so much could be done to improve a simple crystal set, but one way of improving reception was to add valves. For the Brownie user, a matching two-stage amplifier could be attached to provide loudspeaker reception. In many cases, a crystal detector was used in conjunction with valve RF and AF amplifiers, and reflexing was common.

A different approach was the 'electromechanical relay', in which a headphone receiver mechanism was coupled to a microphone. Energised by dry cells, there was sufficient power for a horn speaker. One well known model came from the English firm of S.G. Brown, who adapted their telephone repeater relay developed about 10 years earlier.

American practice generally was not to bother with crystals in valved receivers. To increase performance of simple receivers, regeneration and reflexing were used extensively, but by 1925, the classic TRF with two RF stages, a grid-leak detector and two audio stages had become practically universal. In our part of the world, there was the whole range of receivers from the superheterodynes right down to the home built crystal set.

Contrasting with the Marconi installation in Fig.2, amateur and broadcast crystal sets were not very complex. Indeed, although they were made at very different times and places, the receivers in Figs.3 - 8 have the same simple unse-

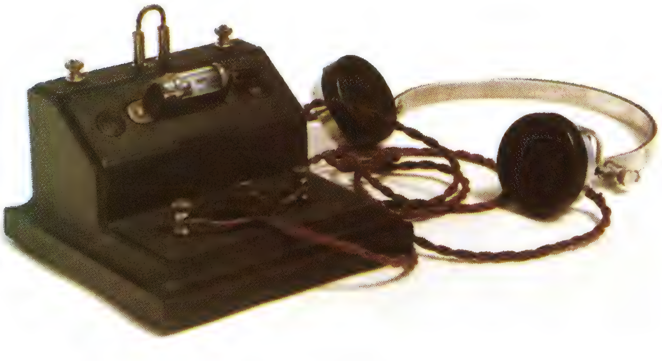


Fig.7: The Brownie Wireless Co. produced several crystal sets, their No.2 having an ebonite case. The coil is inside, tuned by a slider between the earphone terminals. For long wave coverage, an additional coil plugged in at the top.

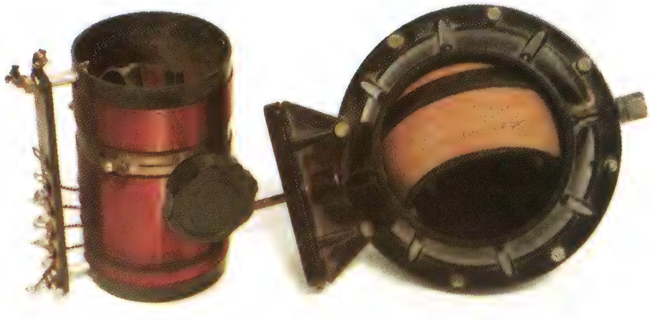


Fig.9: Variometers were frequently used as variable inductors for tuning in the better grade sets, such as the GEC model in Fig.3. They could also be used to provide variable coupling in double-tuned sets.

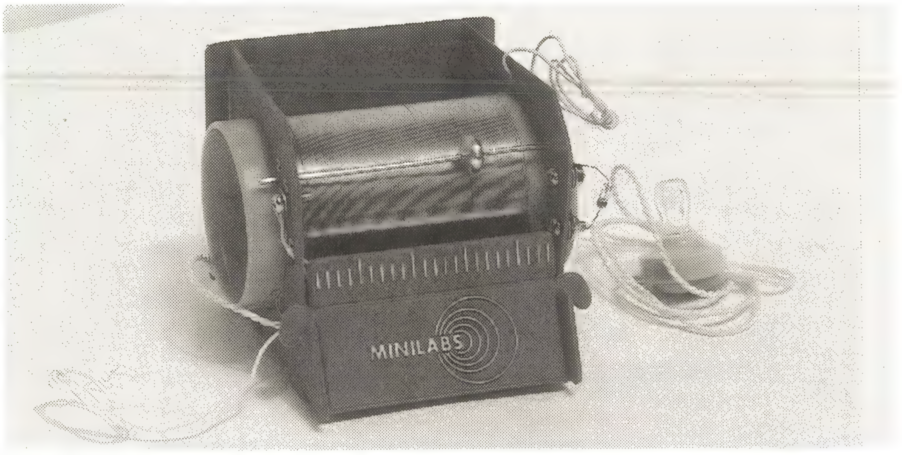


Fig.8: Plastic may have been substituted for ebonite and wood, and the crystal diode is non-adjustable, but today's basic crystal set has not otherwise changed in 70 years. This one comes as a kit from Dick Smith Electronics.

lective circuit, and this was to be their downfall. While there was only one transmission in the area, there was no problem; but if more stations opened, the inherent lack of selectivity became all too apparent.

I confirmed this by tests with the Brownie and the Dick Smith Electronics receivers. With five local transmissions of similar strength spaced fairly evenly over the broadcast band, it was not possible to separate the stations completely, the best compromise being an annoying background from at least one interfering transmission.

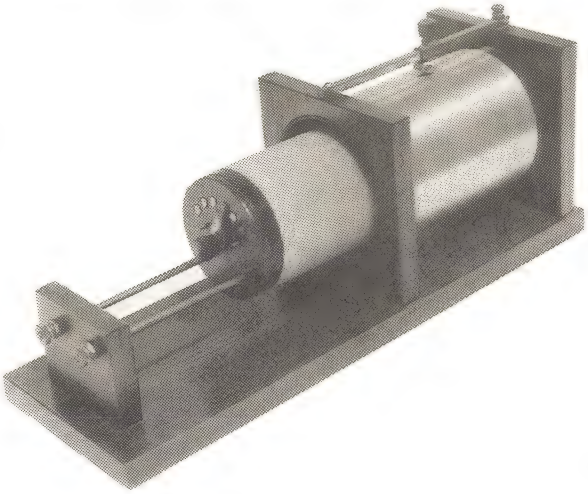


Fig.10: The expert's crystal set was often built around a loose coupler, which could be up to a metre in length. Both coils were of variable inductance, via switched taps or a slider. The position of the inner coil allowed adjustment of the coupling — not a thing of beauty, but very effective.

Huge variety

The solution was of course, improved selectivity; but the problem was to achieve it without sacrificing precious signal strength. Tapping the aerial and crystal down the coil would certainly reduce loading, but at the cost of volume.

For the experimenter, an endless variety of clever circuits now followed, each one claiming to be the answer. It is amazing the remarkable number of variations that were created around the simple crystal set. Virtually every issue of the numerous radio magazines that came on the scene had some new design or circuit configuration. Few, however, approached the Marconi Multiple Tuner in complexity and versatility.

In fact, there *is* a way of combining selectivity and sensitivity, and is the principle of operation of the Marconi tuner. This is to have two tuned circuits, critically coupled with one tuning the aerial system and the other feeding the detector.

Given large, high Q coils each tuned to the operating frequency, and accurately coupled to each other electrically or physically, it is possible to have an efficient transfer of one narrow frequency band. Too close a coupling passes a broad range of frequencies, whereas minimal coupling causes excessive attenuation.

We are familiar with this characteristic in superheterodyne IF transformers. As these operate at one frequency, the spacing of the coils can be fixed, but for a crystal set which has to tune a range of frequencies, the coupling has to be adjustable.

Two popular methods of controlling coupling were the *variometer* and adjustable coils mounted on swinging arms. Very impressive crystal sets were also built around the *loose coupler*. With skilled operation, the loose coupler can produce quite remarkable results, but these are rather large technical looking devices, some approaching a metre in length — although the one illustrated in Fig.10 is only half this.

Modern germanium or diodes are very efficient, but theoretically they could benefit from a small bias voltage. Recently R.G. Newlands of the NZVRS carried out some quantitative research into biasing germanium diodes and found that there was about a 3dB improvement, which is just discernable, in rectified voltage by applying about 0.75 volts of forward bias. For extracting the last fraction of performance this is probably worthwhile. For someone who wants a bit of variety, and a challenge, there is still scope for experimentation with the humble crystal set.

As I indicated at the beginning, although the crystal set is a deceptively simple device, there is a lot that can be written about it. But I suspect that if I carry on much longer at this stage, the Editor may reach for the delete key!

(Editor's Note: For those who do want to experiment with a crystal set, I described a very flexible model back in June 1988 — the 1988 Deluxe Crystal Set. This includes two tuned circuits with 'preset' adjustable coupling, and also adjustable DC bias for the diode. Photocopies of the article are available from our Reader Information Service.) ❖

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Fax: 612 743 2066

READER INFO NO. 22

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

July 1944

FM broadcasting: With an eye to postwar expansion, the General Electric Company of America is pushing hard the advantages of frequency modulated, as against conventional amplitude-modulated broadcasting equipment. GE have launched a reservation plan, whereby broadcasting companies are encouraged to reserve transmitting equipment which will be supplied in rotation after the war as when conditions permit.

Cheaper television receivers: A new projection system which may cut the cost of television receivers to a fraction of that of conventional types, was announced by Emerson Radio & Phonograph Corporation. The television instrument, approximately 18" wide and 14" high, will be a complete radio and television unit employing a 3" cathode ray tube. The television image will be enlarged and projected to 15" by 20" proportions with a motion picture screen, by means of a lens system made of plastics. The brilliance will equal that of home movies.

"It is our plan to feature these sets for no more than $150 as compared with the prewar average price of $500 to $800 for the 12" image type of receiver," said Mr Abrams, president of the corportion.

July 1969

Light emitting diodes: Gallium-arsenide-phosphide light emitting diodes which produce a bright red light have been introduced by Hewlett Packard as panel and circuit status indicators where low drive and high reliability under adverse conditions are important. With an input power of 15mW (10mA at 1.5V), they achieve a brightness typically of 120 foot-lamberts. Maximum brightness under steady-state conditions is about 200fL, but the diodes can be pulsed to much higher levels of brightness. The limit is determined by the maximum dissipation (15mW continous). The diodes are packed in a modified TO-46 transistor enclosure with a window on the top.

Colour TV transmission: The first ever transmission of PAL colour television across Sydney was made during the recent IREE Convention. The transmission was by microwave link from the showrooms of Philips Electrical Pty Ltd, at 79 Clarence Street to the ballroom of the Wentworth Hotel, the Convention. On the ground floor of the Philips showrooms a colour television studio was set up with all the necessary equipment for production of colour pictures.

Medical telemetry: A short range telemetry system for patient monitoring has been developed by the UK Atomic Energy Authority in collaboration with the Middlesex Hospital Department of Clinical Measurement.

The patient has electrodes fixed to his chest by adhesive, and wires from these electrodes are connected to a small radio transmitter (here held in the patient's hand). Signals are picked up by a receiver and are shown as an electro-cardiogram on the oscilloscope. ◆

EA CROSSWORD

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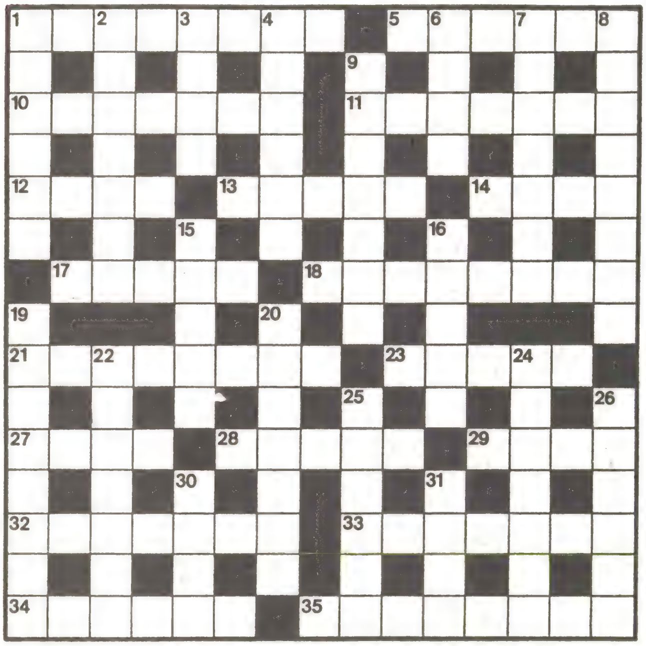

SOLUTION FOR JUNE 1994

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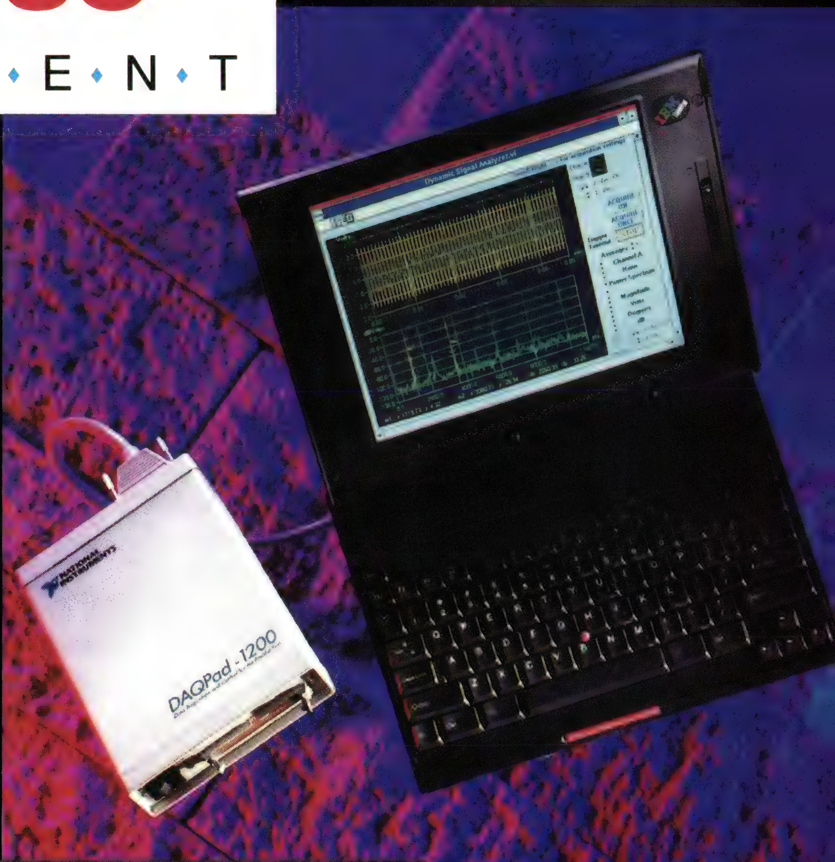
S•U•P•P•L•E•M•E•N•T

NEW VIDEO FRAME GRABBER, VGA/PAL STANDARDS CONVERTER FROM LAKO VISION

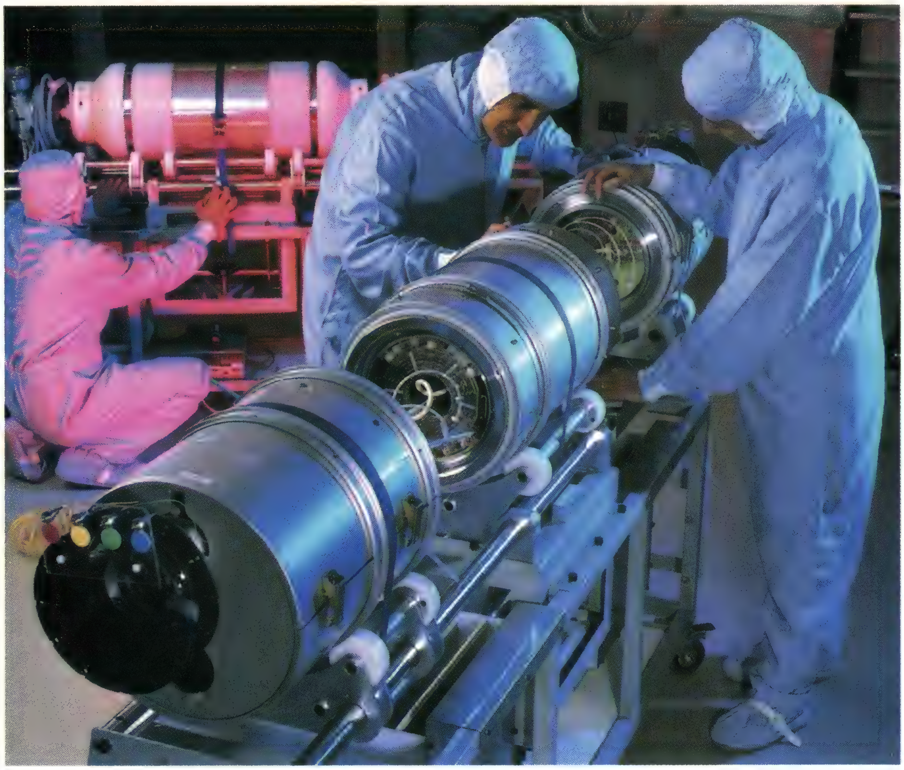
ALCATEL'S PACRIMWEST F-O SUBMARINE CABLE LAUNCHED IN SYDNEY

DATA ACQUISITION USING LAP-TOP PC'S: ELEGANT SOLUTIONS USING PCMCIA, PRINTER PORT INTERFACES AND DAQ SOFTWARE FROM NATIONAL INSTRUMENTS


NATIONAL INSTRUMENTS
DAQPad-1200
Dynamic Signal Analyzer.vi

NEWS HIGHLIGHTS

PACRIMWEST F-O CABLE COMPLETED



Recently manufacture and assembly of the PacRimWest undersea optical fibre cable was completed by Alcatel TCC in Sydney, and loaded onto the cable laying vessel *Cable Venture* at the company's Port Botany terminal. By the time this issue is published, the *Cable Venture* should have finished laying the cable between Australia and Guam, thus completing the final phase of the 16,500km South Pacific Network — linking Australia and New Zealand with Asia, North America and Europe.

Fully constructed in Australia at its Port Botany and Liverpool plants, the completed cable measured 7080km in length and included 53 optical repeaters. It was fully assembled and loaded onto the *Cable Venture* for laying in a single continuous operation — becoming the world's longest optical fibre cable link to be laid in this way. As the completed cable weighed 6755 tonnes, only a ship with the capacity of *Cable Venture* was capable of carrying out the operation. Even so, the vessel's laying equipment had to be enhanced for the job.

The laying route for PacRimWest crosses two of the world's deepest ocean trenches, the San Cristobal Trench near the Solomon Islands (almost 8000m deep) and the famous Mariana Trench, near Guam (almost 9000m deep). These make PacRimWest the deepest submarine cable ever laid, and presented a considerable challenge for both Alcatel TCC engineers, in designing the cable, and the crew of the *Cable Venture* in laying it.

The cable itself was provided with a special additional layer of protective insulation to facilitate laying, and supervisory systems on board the ship (supplied by Alcatel TCC) allowed continuous testing during the laying process.

The export revenues generated by PacRimWest for the Australian economy are greater than $250 million, according to Alcatel TCC Chairman Mr Bill Page-Hanify.

The company has recently won a contract to build the $180 million T-V-H cable, which will link Thailand, Vietnam and Hong Kong.

HACKERS CRACK VIDEOCRYPT CODING

According to a report in *Coop's Technology Digest* (April 29, 1994), a consortium of counterfeit card producers released in late April full details of the Videocrypt scrambling system used by Pay TV systems such as the UK's Sky Network. The details were released via some 25 computer bulletin boards, and included a software program which allowed anyone with a PC to 'hack' the system and watch any desired programmes, defeating the encoding.

John McCormac, publisher of the Ireland-based *Hack Watch News*, is quoted by *CTD* as having examined the information and tested the software, and commenting that "This may be the final nail in the Videocrypt coffin. From this point on, Videocrypt as a scrambling system is dead." McCormac, an acknowledged authority on scrambling systems and pay TV piracy techniques, said he believed the move was the result of intense competition between Videocrypt counterfeit card sellers.

HAMFEST IN NORTHERN NSW

Summerland Amateur Radio Club, based in Lismore, Northern NSW is holding its annual Club Hamfest on July 31 at the clubrooms in Richmond Hill. There will be 'bring and buy' stalls, disposals stands and radio demonstrations, with refreshments available.

The club is also planning to take part in the International Travel-Fest, to be held in the Lismore City Hall on August 6-7. It is hoped to set up communications links with the various countries which will be involved in the Travel-Fest.

Later in the year, on November 26, the club will be holding its Grand Computer EXPO, also in Lismore City Hall. This event will include many commercial exhibits and displays of the latest computer and electronics technology.

Further information on all of these events, or on SARC activities, is available from the club at PO Box 524, Lismore 2480 or by contacting Steve VK2JSM on (066) 62 6693; Ric VK2EJV on (066) 89 5137; or Graeme VK2GJ on (066) 85 1336. Information is also available on local BBS's, on VK2EA-1 or VK2YDN-1, via VK2RPL-2.

SONY RELEASES MD DATA DRIVES

Sony has begun shipping an external data storage device for computers, using its MiniDisc technology. Known as the MDM111, the new drive is almost identical in size to a 3.5" floppy disk drive (102 x 149 x 25.4mm) and operates from a single +5V DC supply. A single MiniDisc will store up to 140MB of data.

Average data transfer rate of the MD drive is 150KB/s, the same as a standard speed CD-ROM drive, with a peak controller-to-host rate of 5MB/s. The average seek time is a modest 300ms, and the drive uses a SCSI-2 interface.

Sony engineers have apparently worked closely with Microsoft to ensure that driver software is available to access MD files from *Windows*, as readily as from hard and floppy disks. The price of the MDM111 drive is quoted as around A$1350, while the MD's themselves are about A$40 each. This gives a value of only 28 cents per megabyte, which is well below floppy disks. With the steady rise in popularity of the MD for audio, it may also become a standard storage medium for PC data and software.

NEW TELECOMMS FOR THE OUTBACK

The 2.5 million people living in remote areas of Australia now have access to world leading mobile satellite and radio services, thanks to two new Telstra initiatives announced in Sydney recently. The mobile voice, facsimile and data services — Satcom-M and Radphone Direct Dial — were launched by Telstra Managing Director-International, Mr Warren Grace.

Satcom-M is a digital voice and fax service which enables callers to directly access the Inmarsat satellite system using a terminal which can be as small and portable as a briefcase. Radphone Direct Dial is an Australian designed high frequency radio service, which can dramatically improve communications for thousands of licensed HF radio users in this country. The technology will service the remote areas of Australia which are not covered by a cellular mobile network (and in many cases by the fixed telephone network), and offers a significant improvement to the safety and productivity of the people who live in this area.

"Australia is leading the world in mobile satellite and radio services", Mr Grace said.

"Not only are these services improving the quality and safety of life in outback Australia, the technology heralds a new era in mobile communications in this country."

Satcom M is a two way digital service operating at 1.5 - 1.6GHz (L band), which will give people in isolated areas direct assess to almost any telephone in Australia or overseas, including access to the Public Switched Telephone Network and cellular mobile phones.

Radphone Direct Dial is the first HF radio service in Australia to enable users to directly dial almost any telephone in Australia. The technology also brings with it fax and data capability — another innovation, expected to be available later

QEDA SHOW IN BRISBANE

The Queensland Electronics Development Association's Annual Trade Show and Seminar was held in Brisbane at the RNA Showground on May 4-5, and organisers were delighted at the excellent conditions provided in the fully carpet covered venue. The free seminars were well attended, and are expected to be a feature of future shows.

This year stands were taken by educational bodies such as Queensland University, Griffith University, QUT and South Brisbane TAFE, displaying research projects being undertaken and providing information on courses available.

Trade exhibitors included Emona Instruments, Philips, Tektronix, Vicom, Jemal, Tech Rentals, L.E. Boughen, Colourview Electronics, Delsound, Cliff Electronics, Peter Martin, QED, E.S. Rubin, Rohde & Schwarz, AES Hartland and Mayer Krieg. The largest stand of all was taken by distributor St Lucia Electronics, which has recently opened a branch in Sydney (trading as Prime Components).

Organisers were a little disappointed with the attendance, which was just under 1000 despite the Show being given considerable publicity in local media, and the distribution of large numbers of trade passes. However there had been a number of trade shows held in Brisbane over the preceding months.

TEKTRONIX
L.E. BOUGHEN & CO
QUT
Queensland University of Tec
MISSION STATEMENT
TEACHING
QEDA
QUEENSLAND UNIVERSITY OF TECHNOLOGY

Door prizes of a JVC colour TV and one of the new Tekmeters from Tektronix were won by Peter Betts of Garden Guard and Don Flint of QUT's Department of Physics, respectively.

this year, which will be the first of its kind in Australia.

TAIT WINS LARGE WA RADIO CONTRACT

One of the largest government contracts ever let in Australia for mobile two way radio systems has been secured by Tait Electronics (Aust). The contract, to the WA Bushfires Board, not only covers the bushfire service but every other government department in the state with a requirement for two way radio.

Tait expects the multi-million dollar contract to result in the sale of 4000 to 5000 radios over the next three years.

The tender was to specifications of the Bushfires Board and the WA Fire Brigade — but also included the requirements of the Water Authority of WA and other departments — because these organisations will be the biggest users of two way mobile radio in the State Government.

The contract means that over the next three years virtually every fire truck, 4WD vehicle and bushfire tanker in WA will be fitted with a Tait radio.

Tait's WA Manager, Mr Mike Gray, said that the new system would mean that the two way radios used by the Fire Brigade and the Bushfires Board would be compatible across the State. This compatibility means that all the state's firefighters will be able to communicate using the same radio system and vehicles containing the radios will be able to work anywhere in the State. However, this is only part of the contract. Acceptance of the Tait 2020 by the State Tenders Board means that every other WA Government Department, Shire, Council and semi-government authority with a requirement for two way radio will be able to buy two way systems on the same terms and conditions as the Bushfires Board.

IRIDIUM ORDERS FIRST TERMINALS

Scientific-Atlanta, the exclusive supplier of satellite earth terminals for the Iridium global communications system, has received the first order for the system from Motorola Inc.

The Iridium project, which will use Low Earth Orbit (LEO) satellites, is now a reality with the first US$15M order placed with Scientific-Atlanta's Electronic Systems Division by Motorola for the supply of an initial 20 tracking antenna systems. The first control terminals are due for deployment this December.

In an effort to provide further security against airline terrorism, British firm Texlon has developed a bar-code system which allows luggage to be identified using a scanner right at the point of loading it into the aircraft luggage bay.

Scientific-Atlanta will supply 10 System Control Segment earth terminals for the Iridium system's telemetry tracking and command centres to Motorola Satellite Communications Strategic Business Unit. The contract also contains options for an additional 20 gateway terminals valued at US$30 million.

Iridium provides a worldwide digital, satellite based personal communications system, with users able to transmit and receive digitised voice, data and facsimile signals via handheld mobile or transportable units anywhere on earth. The system is based on a constellation of small, smart LEO satellites networked together as a switched digital communications system.

"Motorola's selection of Scientific-Atlanta to provide the earth stations for the Iridium system is a significant addition to our company's participation in the personal communications network market," said Steve Dean, Managing Director of Scientific-Atlanta Australia.

"Our association with Motorola and the Iridium team is supported by our success in providing products, systems and technologies to support low orbiting satellite based global communication networks."

Motorola Satellite Communications Division Corporate Vice President and General Manager, Durrell Hillis said the contract marked a 'significant milestone' in the development of the Iridium system.

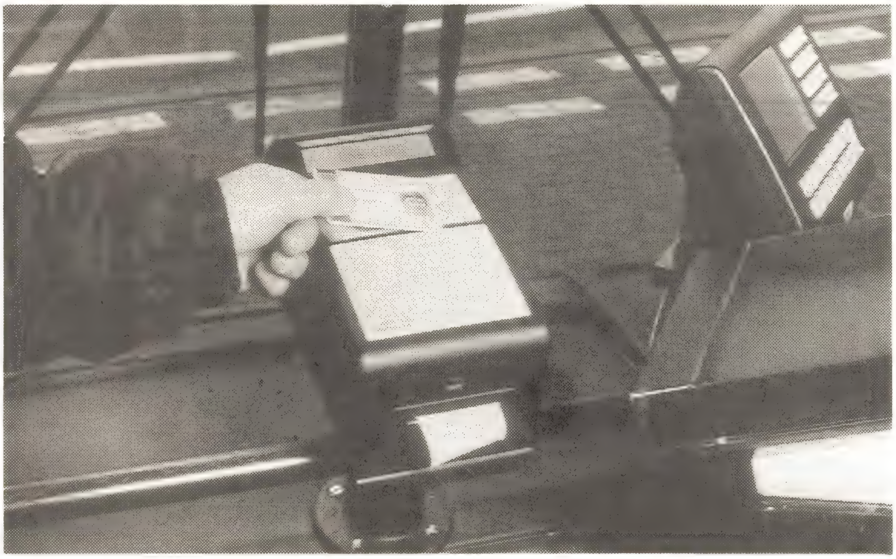
Motorola will launch satellites just 200 kilometres from the earth's surface, and in sufficient quantities to ensure that a following satellite will collect any signal missed by the previous one. The $4.9 billion Iridium project is scheduled to be

NEWS BRIEFS

- ***Veltek*** has opened a Queensland office at 32/17 Herston Bridge Road, Herston 4006, phone (07) 216 0770, fax (07) 216 0772.
- ***Av-Comm*** has moved to new premises at 198 Condamine Street, Balgowlah. The phone numbers remain unchanged at (02) 949 7417/948 2667 and (fax) 949 7095.
- The Entertainment Technology show ***Entech '94*** will be held at the Sydney Exhibition Centre, Darling Harbour, Sydney from October 6-8, 1994.
- ***Independent Information Technology Training*** is holding a PC Troubleshooting course at Sydney, August 31 - September 2; Melbourne, August 24-26. Phone toll free 1800 654 103 for more information.
- ***Philips*** activities in Australia are to come under the new name of ***Philips Electronics***.
- ***Wedgetail Technologies*** has been appointed the Australian distributor for IFI of Ronkonkoma USA. IFI make RF and EMC test equipment.

deployed in 1998, with first satellite launches in 1996.

OZ SMART CARDS FOR UK BUSES



In preparation for the largest application of contactless smart cards in the world, a trial has begun in Manchester in the United Kingdom to revolutionise the collection of fares and payment for services. The contract for the supply of the smart cards for this trial was awarded to Intag International Limited, a Sydney based company.

Intag's contactless smart card technology enables passengers to board the Manchester buses with minimal delay and inconvenience. The In-Charge system uses radio waves to exchange data between the bus ticketing systems and the smart card held by the passenger. Passengers no longer need to stop and search for the correct fare or insert a paper ticket into a reader on the bus.

Passengers simply present the card to the reader. The card can also be read effectively even when left inside a purse, wallet or handbag.

Intag delivered 5000 of its In-Charge cards and 145 readers between February and April this year. These cards are now in regular use operating successfully throughout the Manchester area.

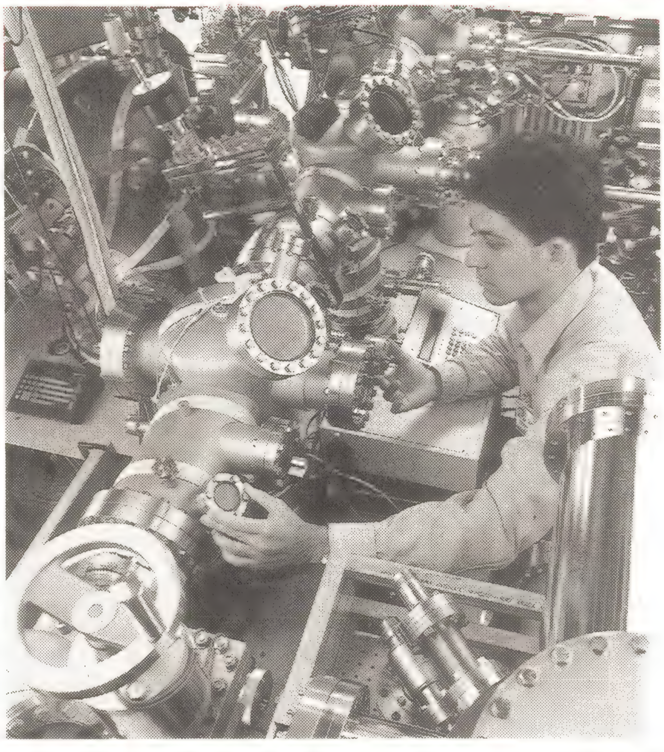
Key to Intag winning this contract was the firm's ability to deliver the most advanced non-contact smart cards that met the demanding requirements of this world-first application. Intag is presently developing enhanced versions of these products, and based on a successful trial is confident of being awarded the contract to supply an additional 500,000 cards to Manchester later this year.

The system in Manchester was installed by another Australian company, ERG Electronics Limited based in Perth. ERG was awarded the contract for the implementation of the system and has supplied and installed the trial system equipment on the buses and at the depots.

At the heart of the In-Charge card is a computer chip developed by Intag employing ferroelectric random access memory, or FRAM. FRAM was also commercialised by an Australian company founded by Intag's Managing Director, Ross Lyndon-James, who commented "There are many worthwhile and innovative technologies developed in Australia. The challenge is to identify and commercialise them internationally."

Intag has also supplied In-Charge systems to customers in Australia, Singapore, Korea and the Middle East. These systems are being used to develop new applications for the In-Charge card. These include access control, toll collection, stored value cards, ski lift passes and customer loyalty programs.

BELL LABS MAKE SELF FOCUS LASERS



Scientists at AT&T Bell Laboratories in Murray Hill, New Jersey, have made the world's first self focusing lasers. The experimental devices, called zone lasers (z-lasers), are unlike conventional lasers in that they need no lenses to focus their light on a specific point. The new devices are predicted to have significant implications for telecommunications, computers and consumer electronics.

"They may have applications in future systems that couple lasers to optical fibre for information transmission," said Niloy Dutta, Head of the AT&T Bell Laboratories' Optoelectrical Device Research Department. "They might also be used in future optical-interconnections on a single chip, between chips, or between circuit boards in a computer; or in future optical recording/storage systems."

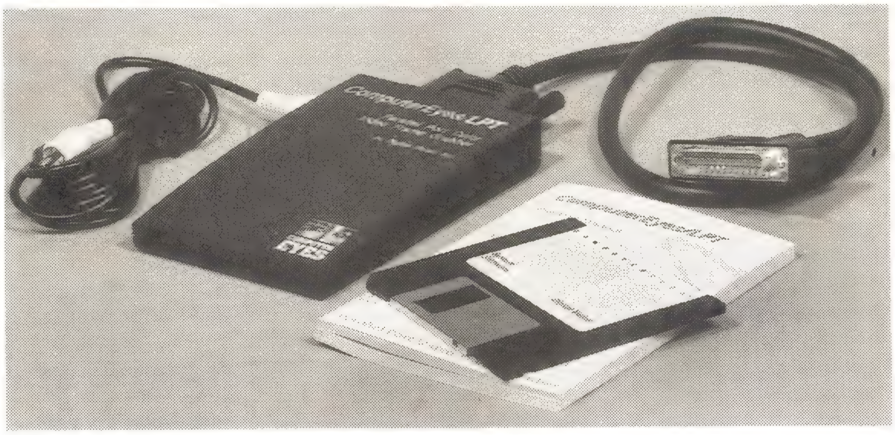
Z-lasers are a new class of laser structure that uses vertical-cavity geometry. They emit light vertically from their surface instead of horizontally as conventional edge-emitting lasers do. They were invented by Daryoosh Vakhshoori, of Dutta's Department. Vakhshoori and researchers Mingh Wei Hong, Moses Asom, James D. Wynn, Ronald E. Leibenguth, and Joseph P. Mannaerts fabricated the lasers using molecular beam epitaxy (MBE), a technique in which precisely controlled layers of various materials as thin as a single atom are deposited on top of one another to form thin films that are the basis for many semiconductor devices.

The z-lasers are made of layers of indium-gallium-arsenide, gallium arsenide and aluminium-gallium-arsenide. Because of the way they are designed and processed, their output light tends to converge, which is not possible with other lasers. ❖

MULTIMEDIA UNITS FROM LAKO VISION

Melbourne-based multimedia specialist Lako Vision now has available two external devices which greatly simplify the exchange of images between computers and video equipment. The ComputerEyes LPT is a compact video frame grabber which connects to the computer via a standard Centronics parallel printer port, while the Vine MultiGen is a VGA-to-video standards converter which incorporates genlocking and freeze frame facilities.

by JIM ROWE

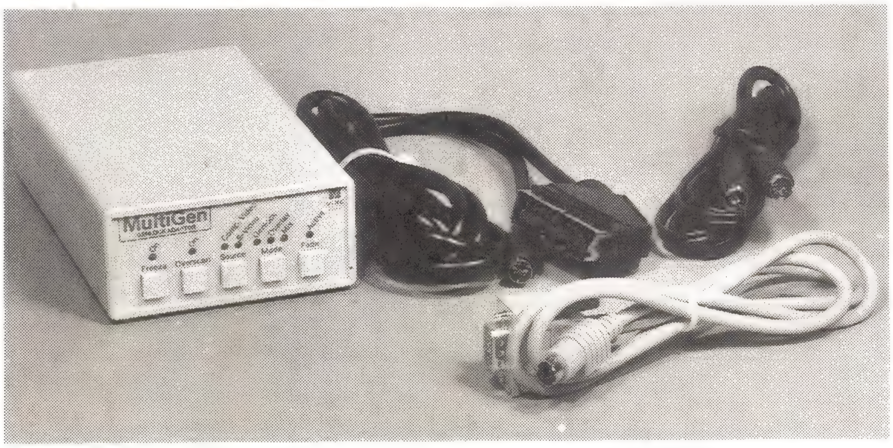


More and more, as part of the so-called 'multimedia revolution', people are needing to feed video images into computers, and conversely feed computer images into standard video recording and display systems. Hence the growing demand for hardware devices such as video 'frame grabbers', video digitisers and VGA-to-video standards converters — and also the software to work with them. This being the case, two new products from Melbourne-based multimedia specialist Lako Vision are very interesting.

Until now, many video frame grabbers have been relatively large 'full length' cards which have occupied a full slot in a desktop PC. As well as requiring the user to open up the PC case to fit them, this has also made them unsuitable for use with laptops and other portables — as well as compact desktop units with no free slots. There can also be memory address, I/O and interrupt line conflicts with other cards in the machine.

The ComputerEyes LPT frame grabber avoids all of these problems, because it's a compact external unit which simply connects to the PC via a standard Centronics-type parallel printer port. The unit is controlled by commands from matching software, running in the PC, and when directed it first 'captures' the current video field or frame, and then sends the information back to the PC via the five 'handshaking' lines of the printer port. The software can then export the image in any of a number of standard formats, for use by desktop publishing, presentation or other image manipulation software packages.

Marketed by Digital Vision, of Dedham, Massachusetts, the ComputerEyes LPT package comprises a very compact hardware box with separate 'plug pack' 9V DC power supply, matching software, owner's manual and all necessary cables. Everything fits in a tidy little zip-up carry bag, for transport.



The grabber box itself measures only 140 x 86 x 22mm, and has a DB-25 connector on the rear for connection to the PC printer port, along with the DC power input connector. An RCA-type connector on the side is used for the composite video input, while a four-pin 'mini DIN' connector on the rear provides an alternative S-video input. There are no 'controls' as such, as all functions of the box are controlled from the PC software.

Two versions of the matching software are supplied, one to run under DOS and the other under *Windows*. In each case the software provides a very convenient way to monitor a black and white version of the video signal on-screen in continuously (but not 'real time') updated form, to freeze the image at any desired instant, and then to transfer it into the PC in full resolution form. The captured image can then be viewed in colour, manipulated and enhanced, and then exported in either colour or grey-scale form in one of a variety of standard formats — including TIFF, PCX, BMP, GIF, Targa and JPEG.

The actual image format used by the ComputerEyes hardware and software is virtually identical to Targa TGA (640 x 480 pixels, 24-bit colour). However images of lower resolution can be derived from this by inbuilt interpolation, for export. Needless to say the compressed JPEG format is very good for exporting images in as small a file as possible.

By the way, I gather that radio amateur 'slow scan TV' enthusiasts have shown great interest in the ComputerEyes LPT package, because the images from it can then be fed into SSTV software for transmission.

The MultiGen

When it comes to transferring images in the other direction, i.e., from a computer to the standard video domain, there have been interface units available for some time. However many of these involve 'forcing' the computer's video card into an unusual display mode, in which the normal monitor cannot produce a stable display. This has often meant that you can feed the images to a video system OR the normal monitor, but not both at the same time.

In contrast with this approach, the Vine Micros MultiGen unit is a true digital standards converter which accepts standard CGA or VGA computer video signals (or signals from a Macintosh VGA, Atari ST, Acorn BBC/Master or Archimedes computer), and produces from them a standard PAL video signal (either RGB, composite or S-video), for feeding to a normal VCR or video monitor. This means that you can view the image on the computer monitor continuously, while also transferring material into the video domain. In fact the MultiGen is designed to 'loop' directly into the cable between the computer's display card and its monitor, and effectively provide a 'video tap-off' to make everything as easy as possible.

Inside the compact MultiGen box, there's a complete real-time hardware scan converter based on a full frame memory, plus picture scaler, genlock and video mixer. The frame store uses 18-bit YUV samples, with a resolution approximately equivalent to 812 x 590 pixels in 256,000 colours.

Because most computer video images use 'underscanning' to ensure that the full image can be seen (unlike standard video, where slight overscan is generally used), the MultiGen's picture scaling facility allows the video image derived from the computer to be enlarged so that it can be blended with normal video. Similarly the genlock and video mixing facilities allow the computer-derived video to be both locked to another standard video source (say a camera), and either mixed with or overlaid on its images. This should be very handy for people who need to combine computer images with 'live' video, for training etc.

Also included in the MultiGen is a 'freeze frame' facility, to ensure stable transfer of static images, and a cross-fade facility for changing from external video to computer video and vice-versa. The timing of the cross-fade can be varied from 0.5 to 4.0 seconds (in 0.5s steps), using some DIP switches on the back of the case. There's also a built-in filter to reduce the image flicker which can result from the conversion from non-interlaced to interlaced format.

Another DIP switch allows the MultiGen to be set for either PAL or NTSC standards, for the video domain input and outputs. These inputs and outputs operate at the standard 75 ohms impedance, with 1V p-p levels for composite video and S-video luminance, and an S-video chrominance burst of 0.3V p-p.

The MultiGen is basically designed to support computer video modes up to 640 x 480 pixels, in 256,000 colours — i.e., VGA format. This means it automatically converts from 320 x 200 (CGA), 640 x 350, 640 x 400 and 720 x 400 modes as well, but not higher resolution modes (i.e., S-VGA or EGA).

All of the normal operation of the MultiGen is controlled via five pushbuttons on the front of the case. These respectively control the freeze frame function; the optional overscan facility; the external video source (composite/S-video); the output video mode (genlock/overlay/mix); and the fade facility. As the MultiGen is fully self-contained, there is no need for special or matching software in the computer.

Our impressions

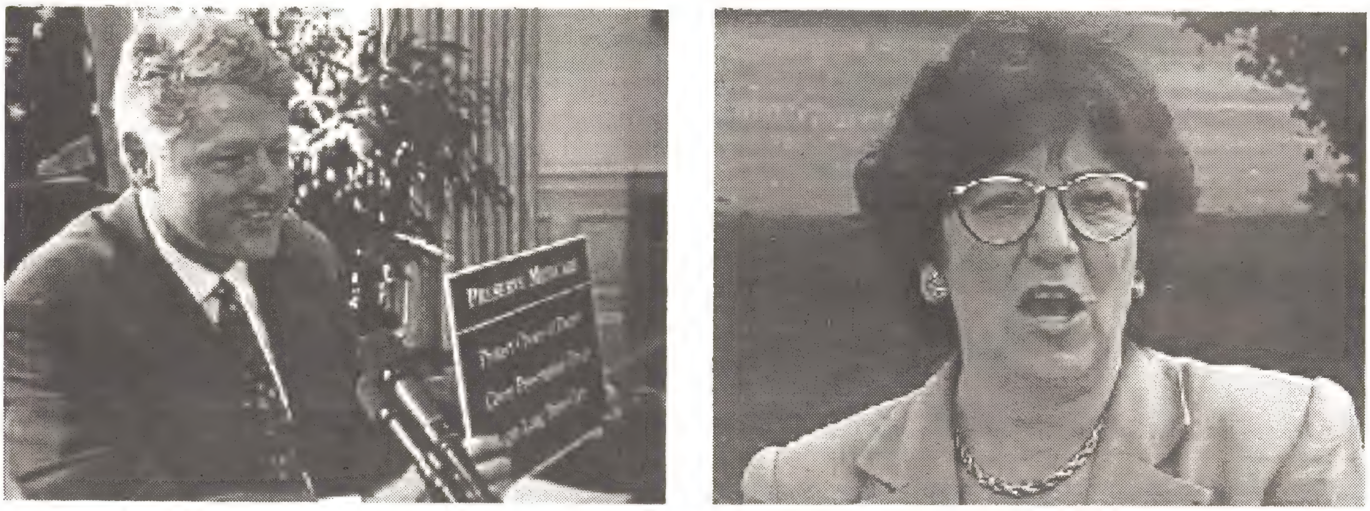
Lako Vision very kindly made samples of both the ComputerEyes LPT and MultiGen packages available to us, so we could try them out in practice for ourselves. We tried both out with two different computers: a 12MHz AT clone, and a 33MHz 486 machine.

We found the ComputerEyes LPT package very straightforward to set up in each case, and both the DOS and *Windows*-based software turned out to be easy and convenient to use. We were easily able to capture a variety of video 'snapshots', from off-air, off-satellite and from a VCR, and it was no problem to export them to other packages as TIFF, PCX or JPEG files. We especially liked the JPEG facility, because of the significant reduction in file size...

Samples of some of the images we captured and exported in this way are shown below, as printed out from *Picture Publisher 4* using a 600dpi HP LaserJet 4M printer. As you can see, they look quite impressive.

The MultiGen package was even easier to use, as essentially it's simply a

Continued on page 120



Two sample TV images as captured using the ComputerEyes LPT frame grabber package, and printed out via Picture Publisher 4.0. President Clinton is taken from satellite TV, while Dr Lawrence is taken from local terrestrial TV.

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

486 from Texas Instruments

Texas Instruments has announced a range of 486 CPU chips. Designated the TI486DLC and TI486SLC, the new devices are claimed to have many advanced features. The devices are priced to be competitive with older 386 devices, but with the enhanced processing power of the 486. Extensive testing and evaluation has been performed by TI to ensure the new CPUs are completely compatible with all existing products on the market.

The new TI486SLC is designed as a notebook device, and offers 5V or low power 3V operation with a saving of up to 60% in power consumption. When a portable based on the 486SLC has not been in use for some time, the CPU enters a special standby mode where power consumption is virtually zero. TI claims that the power savings made possible by the SLC chip will lead to smaller portables, offering lower weight and longer battery life.

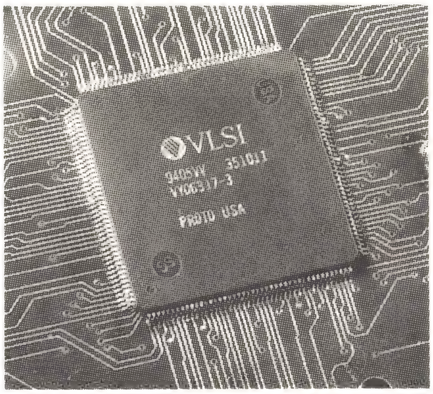
The TI486DLC version is a full 32-bit external data bus device, offering all the power and facilities demanded by desktop systems. They have the same circuit board footprint as existing 386 chips, allowing a manufacturer to upgrade older designs with minimal changes. Alternatively, they are available in a 486 footprint aimed at the new 'green PC' market. Both devices use a pipelined architecture to optimise instruction execution, and thus improve performance. In addition, an on-chip data cache cuts data reads from main memory by up to four clock cycles. Unique among CPU chips, the TI devices feature a built-in hardware multiplier that speeds up math intensive applications such as CAD. Windows is said to also run more efficiently.

Texas Instruments has embarked on an extensive certification and benchmarking program to ensure that the new chips are fully compatible with the huge range of PC DOS, Windows, OS/2 and UNIX applications. Hundreds of applications have been tested including all the most popular word processing, spreadsheet, database, programming languages, games, LAN utilities, diagnostics, communications software and more. A huge range of hardware add-ons has also been tested to ensure complete compatibility.

For further information circle 271 on the reader service coupon or contact Texas Instruments Australia, 17 Khartoum Road, North Ryde 2113; phone (02) 910 3100, fax (02) 878 2489.

Communications processor

VLSI Technology has announced the 'Ruby' advanced communications processor chip, designed for a wide variety of communication applications in the wireless, network, industrial and consumer marketplaces. Using a 32-bit RISC processor core along with a comprehensive set of communication peripherals, extensive power management features, and operation over a 2.7 to 5.5V range, Ruby provides a fast turn-around, low cost and low power solution for PCMCIA, ISA and embedded controller applications such as cellular digital packet data (CDPD), wireless LAN, modem, data acquisition and industrial control.



The Ruby chip contains a PCMCIA/ISA interface which supports direct memory, attribute space, and communication port modes; a UART (16C450), a serial communications controller, a programmable input/output, and a serial port controller. These peripherals, combined with command, standby and sleep power management modes and 2.7 to 5.5V operating range makes Ruby particularly suited for portable communication applications. Power dissipation is 110mW at 3.3V with a 25MHz clock and 200mW at 5V with a 30MHz clock. Power drops to 3mW in sleep mode and 0.2mW in stopped mode, where circuitry is halted waiting for an interrupt.

For further information circle 274 on the reader service coupon or contact GEC Electronics Division, Locked Bag 29, Rydalmere 2116; phone (02) 638 1888, fax (02) 638 1798.

3V serial-data interface is fast

Maxim Integrated Products has released the MAX562, a three-driver five receiver serial-data transceiver, capable of data rates to 250kbps. With a guaranteed minimum slew rate of 4V/us, the MAX562 is claimed to be the fastest available transceiver designed specifically for notebook and palmtop computers. Its compliance with the EIA/TIA-562 standard guarantees compatibility with RS-232 ports.

The MAX562 operates from 2.7V to 5.25V, making it suitable for 3V/5V dual-supply systems. In the low power shutdown mode it draws only 60uA of quiescent current, yet all five receivers remain active. In this mode the MAX562 can monitor five lines, each with data rates to 20kbps. In complete shutdown it draws only 10uA, during normal operation it consumes 40mW.

The three driver outputs and five receiver inputs are on the same side of the IC to simplify layout. To reduce board space, it comes in 28-pin SO and SSOP packages (the SSOP is 60% smaller than the standard 28-pin SO).

For further information circle 272 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

DC-DC converter is 94% efficient

A critical need in many battery applications is to squeeze the last drop of energy from a 9V transistor radio battery, over the widest load-current range possible. The MAX639/MAX640/MAX653 from Maxim is a family of DC-DC converters that achieves this goal with efficiencies exceeding 94% even for output currents as low as 2mA or as high as 225mA. This performance is the result of an ultra-low, 20uA maximum quiescent current (10uA typical) and a very large on-chip MOSFET switching transistor.

The MAX639 is preset for an output of 5V. The MAX640 is preset for an output of 3.3V and the MAX653 is preset for an output of 3V. Maxim's 'Dual Mode' design also allows the outputs to be adjusted by an external resistor divider on any device. A dropout voltage of only 0.5V provides regulated operation over the widest possible input range.

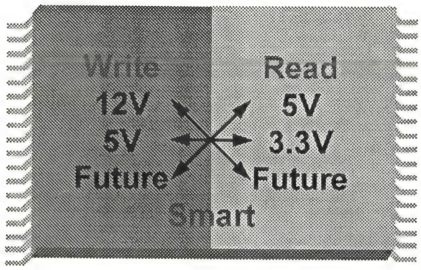
These devices require an inductor, a diode, and two capacitors to be externally connected. The design allows the use of small surface mount inductors. Applications include +5V regulation from a single 9V battery or from multiple battery stacks in portable instructions that use 5V, 3.3V, or 3V logic circuitry.

The devices are available in 8-pin DIP and SO packages in the commercial 0°C to +70°C), extended industrial (-40°C to +85°C), and military (-55°C to +125°C) temperature ranges.

For further information circle 276 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

Flash chips are multi-voltage

Intel's SmartVoltage is a technology that allows flash memory devices to operate with different supply voltages. For example, a 5V flash memory device might operate with a 12V write voltage for maximum performance and a 3.3V read voltage for low power consumption. If these supplies are not available, it can still operate from 5V. The aim of the technology is to allow designers to choose the optimum voltage for an application, while retaining compatibility with 5V only systems. The technology can be thought of as a small module that is added to existing Intel FlashFile and Boot Block architecture components.



The SmartVoltage circuitry senses the Vpp pin voltage, and if it is 12V, direct, high speed erase and write operations to the flash array are enabled. If 5V is detected, two charge pumps are invoked. The circuitry also senses the Vcc voltage. If 3.3V is present, then low power reads are enabled. If 5V is detected, then 5V reads are used.

Intel claims designers can now have Intel products in 5V only systems, or design systems to take advantage of a 12V write and/or a 3.3V read supply. Intel has stated there will be no pricing premium over comparable 12V devices.

For further information circle 289 on the reader service coupon or contact Intel Australia, PO Box 1486, Dee Why 2099; phone (02) 975 3300.

Low voltage 16Mb DRAM

Toshiba has introduced a series of 16-megabit DRAMs offering high performance and low voltage operation. They are designed for use in portable PCs, and will support design of more compact, power efficient systems.

The new TC51V series consists of two models with a 1M x 16-bit structure, both operating at 3.3V. Mass production was to start in March, at a total volume of 10,000 units a month.

Rapid development of high performance CPUs, and the increasing size of operating systems and application software demand that computers incorporate from 4MB to 8MB of memory as standard. This is also true of portable PCs, which must offer users capabilities matching those of desktop models.

Today's standard memory capacity requires between eight and 16 space consuming 4M DRAMs, while expanded memories need 24 or more chips. The same capacity can be achieved with only a quarter of the number of 16Mb DRAMs, allowing development of more compact systems.

Current consumption is 80mA with an access speed of 70 nanoseconds, even at 3V. Performance is complemented by a chip size of only 123.5mm².

For further information circle 290 on the reader service coupon or contact Toshiba Australia, PO Box 350, North Ryde 2113; phone (02) 887 3322.

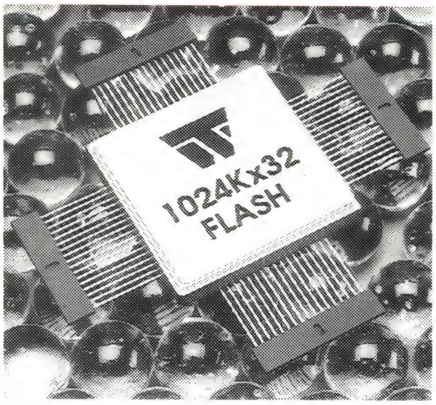
1MB flash memory module

White Technology has announced their WF-1024K x 32 CMOS family of compact FLASH PROM 32-bit configured memory modules. These 32-megabit modules feature a uniform sectored design of 16 equal size sectors of 64K bytes each. This allows easy update of selected sectors, since any sector or combination of sectors can be erased and rewritten.

Designed for surface mounting, the compact 68-pin ceramic quad flat pack (CQFP) devices are housed in a hermetic ceramic package, measuring 35mm square and standing 5.5mm high. A 3.55mm high package for low profile applications is under development.

The WF-1024K43 features low power CMOS design, TTL compatible inputs and outputs and is suited for use as high density memory for program storage and data acquisition. The modules are guaranteed for a minimum of 100,000 erase/program cycles and are available with access times of 100ns and 150ns. Programming voltage is 12V, while supply voltage is 5V. Typical standby current is only 4mA.

The modules are constructed on a multilayer ceramic substrate and hermetically sealed with a welded metal cover. Because of their rugged construction and small size, they offer better mechanical stability in applications where acceleration, shock, vibration and space are major considerations. As a further option, all devices are available in a compact PGA type 66-pin hex-in-line hermetic ceramic package that also measures 35mm square, standing 5.46mm high. Prices for the 68-pin CQFP Military temperature models are US$950.



For further information contact White Technology, 4245E, Wood Street, Phoenix, AZ 85040, or phone USA (602) 437 1520.

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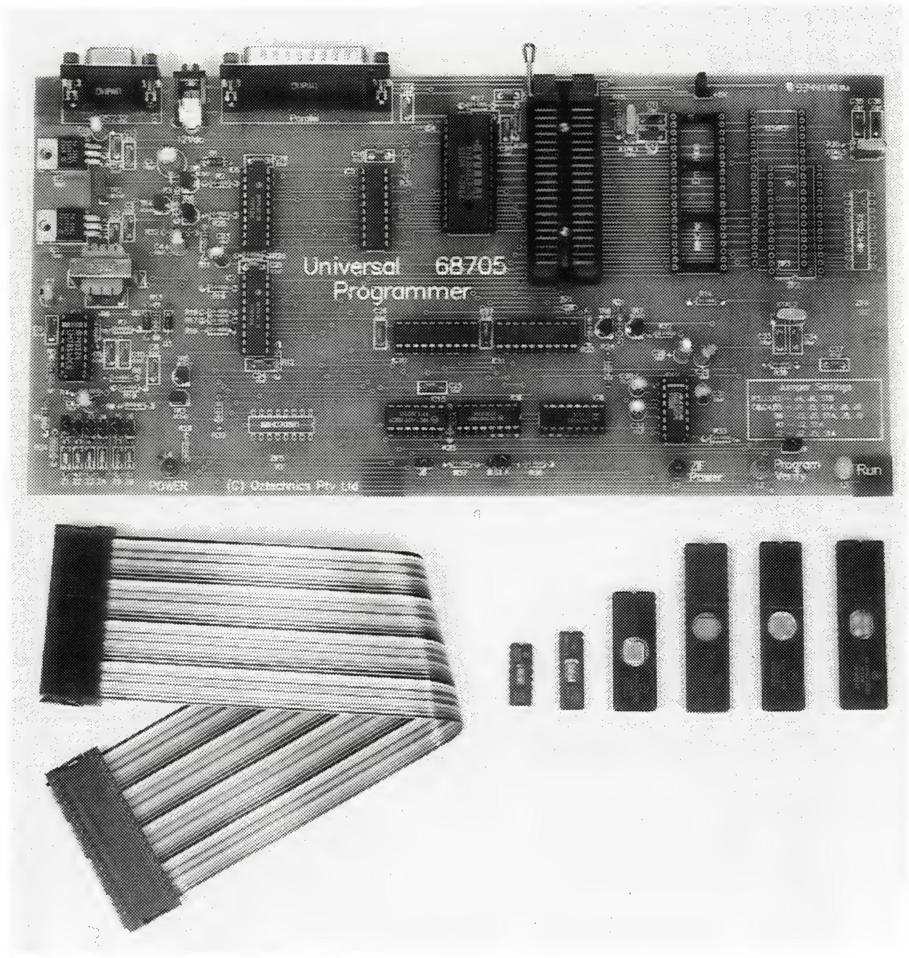
Simulator/programmer in 68705 development system

This Australian designed 68705 microcontroller development system comprises a multifunction programming board and sophisticated software that includes an in-circuit simulator. As the complete system only costs around $280, we were very interested in having a look at it.

by PETER PHILLIPS



This is the programmer board. Buy it as a kit, or assembled and tested.

These days, microcontrollers are used in nearly everything electronic, so it's not surprising to see cheaper and better development systems being produced for these devices.

The basic needs are a means of writing and testing the software, usually with a computer-based emulator, a hardware programmer to burn the EPROM in the microcontroller, and, if you're lucky, some method of testing the actual circuit prior to committing the code to the microcontroller's EPROM.

In March 1993, we presented as a project a PC-based 68705 development system which comprised the hardware to 'burn' various members of the Motorola microcontroller family, plus simulation software to test the program being developed. This system proved so popular that its designer, Robert Priestley, decided to extend the system into a fully professional version with many more features.

Perhaps the most important facility offered by this system is in-circuit simulation (ICS). We'll explain this later, but first a quick look at what the system has to offer.

Supported micros

The standard system supports the following members of the Motorola 68HC705 microcontroller family: the K1 (16-pin), the J2 (20-pin), the P3/P5 (28-pin), the U3/U5, the R3/R5 and the C8/C4 (40-pin).

The system can be extended with adaptor boards to accept many other Motorola uC's, including the 68HC705 C9, D9, P6, P9, E1 and B5.

Programmer PCB

The programmer board connects to a PC via a parallel port and, for some microcontrollers, also via a serial port to access special functions of the uC.

You can either buy the programmer hardware as a kit, or already built. Construction is easy as the PCB is a professional quality, double sided, screen printed board with plated-through holes.

To program a microcontroller, you simply insert it in the appropriate socket on the programmer board, select the programming voltage with jumpers, and press a few computer keys to make the software do the rest.

Producing the software in the first place is done initially with a text editor. The source code from the text editor is then converted into Motorola's .S19 format using a cross assembler (supplied with the package).

Software simulation

The software simulator is used to test and debug the program before committing it to the microcontroller's EPROM. The screen dump in Fig.1 shows how the screen looks during simulation. To a novice, the screen looks rather full and complex. But to the 68705 programmer, the screen is showing virtually everything that is going on in the uC while the program is being executed.

The uC memory map (RAM and ROM) is at the top of the screen, flanked by lines showing the memory address. The memory map is colour coded, where red is I/O, yellow is EPROM, white shows RAM, cyan identifies the bootstrap ROM, magenta is the mask option register and black shows unused addresses.

The source file of the program being tested is displayed in the lower half of the screen, with the total clock cycles and the interrupt clock cycles on the right. All registers for the particular uC are displayed at the top right of the screen.

The simulator will trap illegal instructions, stack overflows, writing to RAM locations used by the stack, and writing to illegal addresses such as PROM or read-only registers. If one of these events occurs, the simulation stops so you can fix the problem.

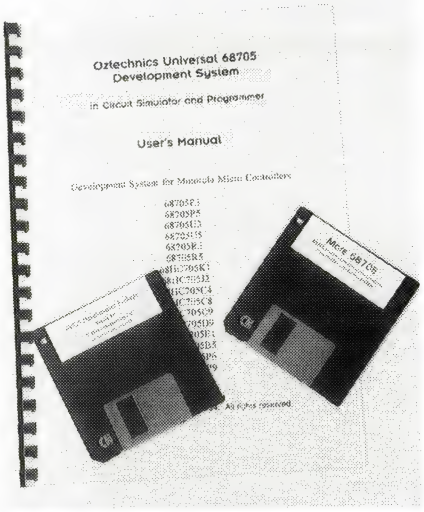
The simulator can be set to step through the program, or run to a breakpoint in the program. Display values can be seen in either hexadecimal, decimal or ASCII.

In-circuit simulation

In-circuit simulation (ICS) is like software simulation, except all I/O processing is done externally. The circuit being tested (target) is connected to the programmer board via a multiway cable.

This cable connects to the socket normally used for the microcontroller in the target circuit (via an adaptor board for some uC's), and to a 40-pin emulation socket on the programmer board.

A C8 microcontroller programmed with a monitor program (supplied on disk) is then fitted into the ZIF socket

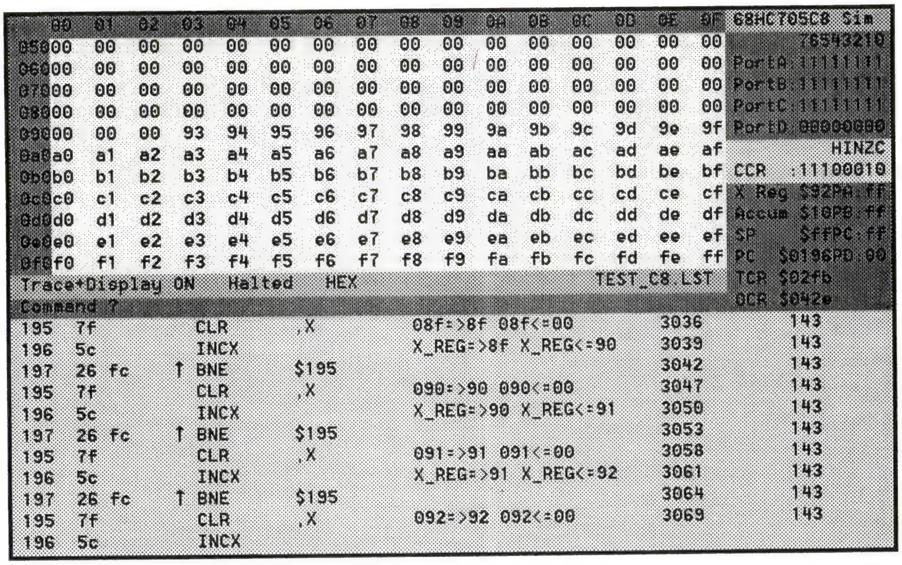

Oztechnics Universal 68705
Development System
In Circuit Simulator and Programmer
User's Manual
Development System for Motorola Micro Controllers
More 68705

The standard kit includes this manual and the disk on the left. The other disk is also available and has many tried and tested 68705 routines.

on the programmer board. The monitor program handles the data transfer between the target circuit and the computer simulating the 68705 program. For instance, when the computer requires I/O data, it sends a request through the serial port to the C8 controller on the programmer board. The controller then obtains the data from the target circuit and returns it to the computer.

This technique allows hardware simulation to be performed, as the simulator screen now shows the logic level actually present at the C8 controller I/O pins.

The program doesn't run at full speed, as it is being simulated by the computer, but it provides a good test of the target hardware.



```
   00  01  02  03  04  05  06  07  08  09  0A  0B  0C  0D  0E  0F 68HC705C8 Sim
05000  00  00  00  00  00  00  00  00  00  00  00  00  00  00  00      76543210
06000  00  00  00  00  00  00  00  00  00  00  00  00  00  00  00 PortA:11111111
07000  00  00  00  00  00  00  00  00  00  00  00  00  00  00  00 PortB:11111111
08000  00  00  00  00  00  00  00  00  00  00  00  00  00  00  00 PortC:11111111
09000  00  00  93  94  95  96  97  98  99  9a  9b  9c  9d  9e  9f PortD 00000000
0a0a0  a1  a2  a3  a4  a5  a6  a7  a8  a9  aa  ab  ac  ad  ae  af         HINZC
0b0b0  b1  b2  b3  b4  b5  b6  b7  b8  b9  ba  bb  bc  bd  be  bf CCR  :11100010
0c0c0  c1  c2  c3  c4  c5  c6  c7  c8  c9  ca  cb  cc  cd  ce  cf X Reg $92PA:ff
0d0d0  d1  d2  d3  d4  d5  d6  d7  d8  d9  da  db  dc  dd  de  df Accum $10PB:ff
0e0e0  e1  e2  e3  e4  e5  e6  e7  e8  e9  ea  eb  ec  ed  ee  ef SP    $ffPC:ff
0f0f0  f1  f2  f3  f4  f5  f6  f7  f8  f9  fa  fb  fc  fd  fe  ff PC  $0196PD:00
Trace+Display ON   Halted   HEX                       TEST_C8.LST TCR $02fb
Command ?                                                         OCR $042e
195  7f          CLR      ,X        08f=>8f 08f<=00     3036       143
196  5c          INCX               X_REG=>8f X_REG<=90 3039       143
197  26 fc     ↑ BNE      $195                          3042       143
195  7f          CLR      ,X        090=>90 090<=00     3047       143
196  5c          INCX               X_REG=>90 X_REG<=91 3050       143
197  26 fc     ↑ BNE      $195                          3053       143
195  7f          CLR      ,X        091=>91 091<=00     3058       143
196  5c          INCX               X_REG=>91 X_REG<=92 3061       143
197  26 fc     ↑ BNE      $195                          3064       143
195  7f          CLR      ,X        092=>92 092<=00     3069       143
196  5c          INCX
```

Fig.1: This is how the simulator screen looks when stepping through a program. The arrows next to the branch instructions indicate the direction of the branch.

In-circuit emulation

This feature only applies to the C8 microcontroller, which also happens to be the most popular one anyway. The target circuit is connected with a 40-way cable via the previously described emulation socket on the programmer board. The C8 controller is programmed with the code under development, but with break points (SWI instruction) inserted at appropriate points in the program. As well, a small interrupt driven routine (supplied) is added to the end of the program being tested.

The programmed C8 is then placed in the 40-pin ZIF socket, which is connected in parallel with the 40-pin emulation socket connecting to the target circuit. When a break point is reached in the program, or a break is signalled from the computer (via the serial port), the additional routine sends the status of the RAM, internal registers and I/O ports to the computer for you to evaluate.

The main advantage is the program (and hence the whole system) is now running in real time. Some faults only show up when running at full speed, so this is the final test.

The package

The complete package comprises the programmer board, a manual and one disk containing the cross-assembler, the simulator and programmer files, as well as numerous sample files and routines to get you going. The manual is well produced and contains the circuit diagram of the programmer board as well as information about the range of Motorola microcomputers.

An integrated text editor/assembler with on-line information about the Motorola 68705 family is currently under development. Designed to interface directly with the simulator and programmer, this program might be available as you read this.

The review package was supplied by Oztechnics. The recommended price for the standard kit is $280, while an assembled and tested kit is $390. A special package aimed at educational institutions is also available. Extras such as Motorola data books, ICE cables, ZIF sockets and additional 68705 routines on disk are also available. Post and package in Australia is $10.

For further information contact Oztechnics on (018) 020481; fax (02) 541 0734, or write to PO Box 38, Illawong NSW 2234. ❖

Silicon Valley NEWSLETTER

Plan for satellite comms network - 1

Two of high-tech's most successful entrepreneurs and billionaires, Microsoft's Bill Gates and McCaw Cellular Communications' chairman Craig McCaw have announced an ambitious plan to build a US$9 billion satellite-based worldwide communications and computer data network, using technology developed for the Star Wars program.

When operational, the network will enable companies to build corporate-computer networks which span the globe, allow corporate managers to conduct two-way video conferences and doctors to instantly review X-ray images of a patient half a world away.

The system would use no less than 840 small low orbit satellites, which will provide worldwide voice and data communications over a high bandwidth.

Gates and McCaw said they have formed a new company, to be known as 'Teledesic', to carry out the project. Teldesic will be based in Kirkland, Washington, and managed by McCaw, who recently sold his cellular telephone company to AT&T for US$12.6 billion.

Apparently, Gates and McCaw have been working on the Teledesic plan for about three years. At its unveiling, many critics said the plan seems too ambitious to be realistic. Even if the project proves technically feasible, Teledesic must still obtain permission from governments around the world to operate in their area. If successful, however, Teledesic would offer computer users — ranging from individuals to multinational conglomerates — a revolutionary means of gaining access to people and information to and from anywhere on the planet.

The main drawback of the Teledesic system is its high frequency band (20 - 30GHz) which requires that the subscriber stays in the same location, thus eliminating wireless computing and communications functions. In return, however, computer users, even in remote desert or polar regions will be able to conduct two way video conferencing, send high resolution graphics and multimedia files from their desktop to that of any other computer user around the world at a cost of only about 10¢ per minute.

Worldwide satellite network - 2

Before the end of the decade, more than 1000 small communications satellites may be buzzing in low orbits around the planet, as the market for worldwide voice and data communications systems has added yet another player. Defence contractor Loral claims it has raised the necessary funds to start building its 'Globalstar' worldwide mobile communications network. Using Globalstar a mountain climber scaling Mount Everest will be able to receive a fax message from a friend on safari in Kenya.

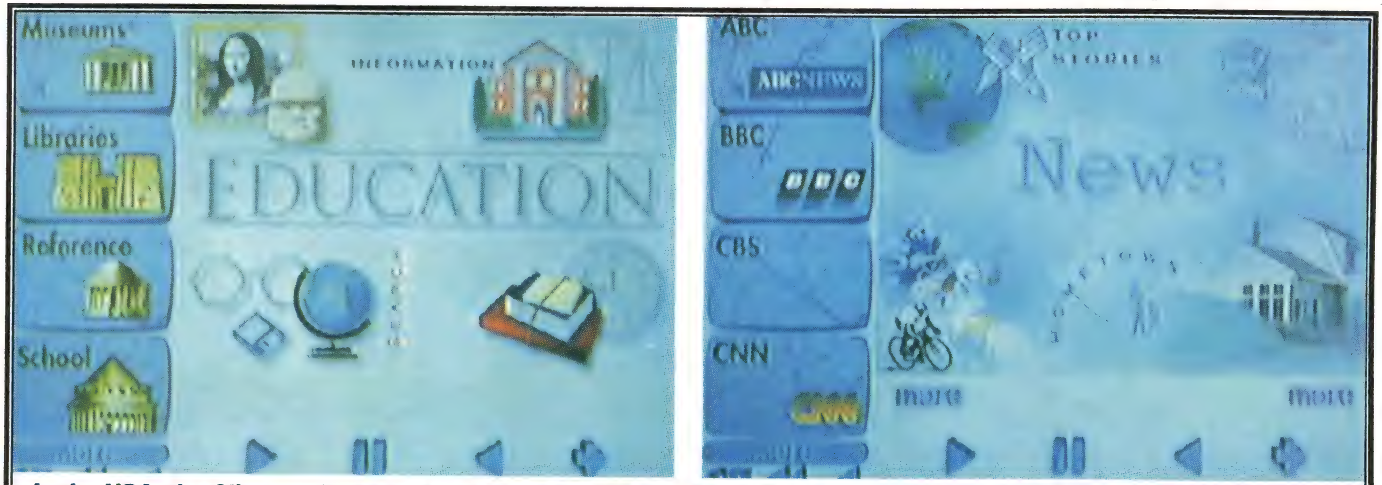
Loral said it has raised the first US$275 million of the anticipated $1.8 billion needed to build the 56-satellite communications network.

Globalstar looks likely to be one of at least five US-based global communications networks. Microsoft's Bill Gates and McCaw Cellular chairman Craig McCaw have announced their plans for a US$9 billion 840-satellite-based-computer-communications-systems, while Motorola is also preparing to put its US$3.3 billion 66-satellite Iridium network into orbit.

Globalstar will use a much lower frequency than the 20 - 30GHz Teledesic will be using. That will limit Globalstar to providing only voice, fax, message paging, and low speed modem connection services. Unlike Teledesic, however, users of Globalstar will be able to use the network for wireless and mobile communications applications. Globalstar will be in limited operation as early as 1998 and achieve full scale worldwide capability a year or so after that.

Patent office cancels multimedia patent

The United States Patent & Trade Mark Office has taken a most unusual step by removing a patent that could have



In the USA, the Clinton administration is pushing very hard both for the creation of national data superhighways and for their accessibility by the public. Here are samples of the kind of interactive television menu screens which will enable users to access the information they want easily.

placed a 'choke hold' on much of the market for multimedia software products.

The Patent Office said it had taken away patent #5,241,671, which it awarded last August to Compton Newmedia — the company that published the world's first interactive encyclopedia. The patent had given Compton the right to seek royalties from companies selling products that combine more than one form of media, such as any combination of text, video, sound and graphics.

Compton caused an uproar throughout the software industry last November when it publicly announced the patent and its intention to enforce it against any producer of multimedia software. At the Comdex show in Las Vegas, the Compton booth represented a riot zone with irate software developers arguing loudly with Compton officials.

"This is a real victory for developers and publishers of multimedia titles," said Philip Dodds, director of the Interactive Multimedia Association.

While Compton will be able to seek to have to patent re-instated, under Patent regulations the company will not be able to have the entire broadly worded patent restored. Instead, the company may be awarded a more narrowly defined patent.

Judge stalls AT&T-McCaw merger

The same Federal Judge that forced AT&T to spin off its regional phone companies in the early 1980s, has ruled that the proposed US$12.6 billion merger of AT&T and McCaw Cellular Communications violates the antitrust provisions AT&T agreed to in the 1984 break-up agreement.

While stating that the proposed merger violated the 1984 agreement, Greene indicated he may reverse his ruling if AT&T can provide additional information and restate its case. In particular, if AT&T can show that the merger would serve in the public's interest, Greene will likely allow the merger to proceed.

AT&T officials said they are prepared "to move quickly to state our case." The company is expected to argue that the combination of the two firms will result in lower operating costs for both, savings the combined company will pass on to its customers in the form of lower rates.

In his ruling Greene said the AT&T/McCaw merger raises the spectre of re-creating the monolithic AT&T organisation he helped break up. This because McCaw's cellular network is partly owned by each of the six 'Baby Bells'.

Industry analysts said AT&T may have to restructure the deal to gain Greene's approval. That means the company may have to offer to sell several of McCaw's most lucrative cellular markets, including Houston and Los Angeles. McCaw has three million cellular customers in 106 markets across the United States.

Piracy case could make legal history

David LaMaccia is a 20 year old MIT computer sciences student who is in deep trouble with the law and the computer software industry. At the same time LaMaccia may turn out the hero of the computer rights movement, which has come to his defence.

Federal prosecutors have charged LaMaccia with illegally distributing millions of dollars worth of copyrighted software application programs, to computer users around the United States. Prosecutors say LaMaccia converted two MIT computers into electronic bulletin boards, which he loaded up with copies of popular software programs. Users across the US who called the bulletin board were then able to copy the software off the board onto their computers.

LaMaccia is defending himself behind the Freedom of Speech and Expression provisions of the First Amendment of the US Constitution.

Under US law, it is illegal for anyone to distribute or make unauthorised copies of copyright protected software regardless of whether there was any financial transaction involved. The legal questions facing LaMaccia and the court is whether anything the student did falls under the law. Until now, distribution has always been presumed to have involved floppy disks and reprinted manuals, not electronic bulletin boards.

According to LaMaccia he initially told only a few trusted friends where on the Internet network they could the programs. But word spread fast, and soon hundreds of Internet users around the United States were copying the software off the board.

Data superhighway alliance falls apart

As quickly as the data superhighway alliances between telephone and cable TV companies were put together, they are now coming apart. Southwestern Bell said its proposed US$4.9 billion partnership with Cox Cable Communications had collapsed, just six weeks after Bell Atlantic called off a US$33 billion merger with cable market leader Tele-Communications Inc (TCI).

Executives for all four companies blame the failed deals on the Federal Communications Commission, and its February decision to force cable companies to lower their rates by 7%. That ruling, industry executives say, has cut the cash flow of cable companies and vastly reduces the money available to develop information superhighways and services.

At the White House, government officials said the cable and telephone companies are using the FCC rate cut as an excuse to terminate deals they no longer wanted to complete, and that telephone companies are concerned that proposed regulations would make it hard for them to build the kind of closed monopolistic networks they had initially envisioned.

The Clinton Administration has recently blasted cable-line data superhighway plans, and has thrown its support behind legislation that would ensure the networks are built on an Internet-like open basis. Such networks would provide easy and low cost access to a diverse group of public and business interests. Vice President Gore has expressed disdain for cable TV-like networks, which he compared to communist-style dictatorships.

"The worst thing you could do is to turn all communications companies into cable companies," said David Lytel of the White House Office of Technology Policy. Industry analysts said the unravelling of the data superhighway alliances reflects the realisation that the revenues and profits from entertainment services such as video on demand are likely to be far less than had been estimated initially.

Intel's 386 wafers for China

Intel has signed an agreement in Beijing that will establish a PRC-based partner for the Santa Clara company. Under the terms of the deal, Intel will ship semi-finished 386 microprocessors to China for final processing. The Chinese partner will sell the finished chips primarily in China, to companies making computers to be used in schools and business.

Intel's executive vice president Craig Barrett signed the agreement with China Huajing Electronics Group based in the city of Wuxi in the province of Jiangsu. The Chinese facility will perform final test and assembly functions.

The 386 chips are a good match for what China needs, analysts agreed. While sufficiently powerful to meet the needs of a large portion of the still very small personal computer market in China, the chips are relatively inexpensive at about US$30 each. Also, communist China remains 'off-limit' to 486 and Pentium-level processors.

With the Intel 386 processor, China will be able to start mass producing 386 PC's as its domestic semiconductor industry will be in a postion to supply most, if not all of the other necessary components to build such computers inexpensively. ❖

NEW PRODUCTS

Triple output power supply from HP

Hewlett-Packard Australia has introduced the HP E3630A triple-output DC power supply which contains three supplies in one compact design. The unit provides three DC outputs: 0 to 6V at a maximum current of 2.5A, and 0 to 20V and 0 to -20V at a maximum current of 0.5A.

Key features include low noise and Hewlett Packard specifies both normal mode voltage noise and common mode current noise. The normal mode noise specification of less than 0.35mV ensures clean power for precision circuitry. With a common mode current specification of less than 1uA, the supply minimises line frequency current injection. It has an 0.01% load and line regulation, separate digital meters that monitor the voltage and current of any output, and auto-tracking where one control adjusts the +20 and -20V supplies simultaneously. The outputs track each other to within 1%.

All ouputs are protected against overload and short circuit damage. Protection circuits prevent output voltage overshoot when the supply is turned on and off.

The supply undergoes the same rigorous tests as HP's top of the line power supplies to ensure maximum reliability and long life. Recommended retail price of the power supply is $800.

For furuther information call Hewlett Packard's Customer Information Centre on 131347, extension 2902.

HEWLETT PACKARD
E3630A
TRIPLE OUTPUT DC POWER SUPPLY
VOLTAGE ADJUST
VOLTS
AMPS
OVERLOAD
METER
OUTPUT
LINE

Multi-function energy meter

Fastron Technologies has released the PM305 multi-function energy meter from Northern Design. The PM305 is suitable for use with single phase and three phase balanced or unbalanced loads to 5000 amps. Many measurement functions are available on the one instrument including kW, kWh, kVA, kVAr (both inductive and capacitive), current, voltage, power factor and frequency. Two independent fully programmable pulse outputs assignable to any of the energy registers are provided.

The meter is equipped with an autocommissioning function which detects and rectifies incorrect CT phasing and warns of phase rotation errors, minimising the probability of incorrect installation.

Solid state registers hold accumulated energy readings when the power supply to the PM305 is interrupted and data retention is claimed to be greater than 10 years in the absence of a supply as the registers do not require batteries. Energy registers can be reset to zero by an authorised user. This feature can be disabled by fitting a shorting link at the rear panel.

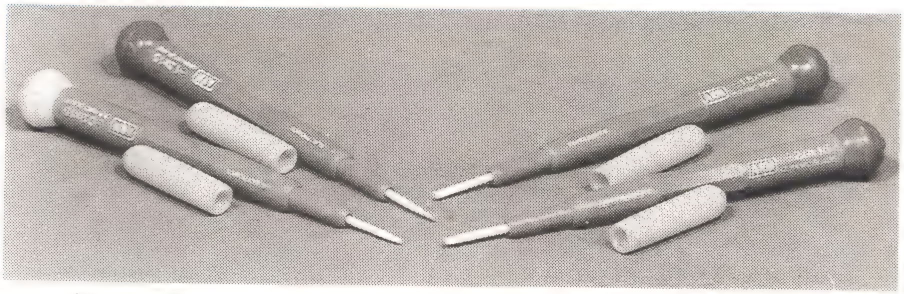
Optional RS232 serial communication allows reading or configuration by a host at 9600 baud, using a two wire (Xon-Xoff) protocol. Two isolated analog outputs are also available as options. The PM305 is supplied in a compact 96 x

Ceramic alignment tools

For efficient adjustment of many preset trimmer capacitors and potentiometers, especially those operating at high impedances and/or high frequencies, it's important to use a non-conductive tool. Even a small piece of metal can create significant additional stray capacitance, disturbing circuit operation and making correct adjustment difficult. Much the same considerations apply to tools for adjusting ferrite cores in inductors.

The best type of alignment/adjustment tools therefore have tips/blades of non-conductive and non-magnetic ceramic, but until recently these have been both expensive and hard to obtain.

Now, however, Dick Smith Electronics has sourced a range of high quality adjusters with zirconia ceramic blades and anti-static handles, designed to be as inert as possible for effectively zero circuit disturbance. The ceramic material is non-magnetic, has no HF eddy current loss, is a high grade insulator, strong and wear resistant, has very low thermal conductivity and can resist temperatures up to 1000°C. Solder will also not adhere to its surface.



There are five models in the range, four with flat 'screwdriver' tips of 0.9mm, 1.3mm, 1.8mm and 2mm width respectively and the fifth with a #0 Phillips head tip. All models are priced at $14.95 each, and carry catalog numbers T-5200, T-5202, T-5204, T- 5206 and T-5208 respectively. Every tool has a 'thrust ball' at the top of the handle for convenient use, and comes with a protective cap for the tip.

The new adjusters are available from all Dick Smith Electronics stores and stockists.

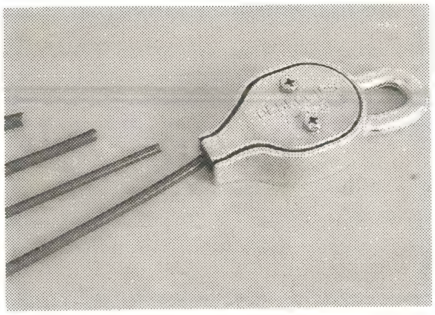
Corrosion free guy wire

Called Debeglass Wire, a new non-conductive guy 'wire' is claimed by its Japanese makers to be stronger than steel for the same cross sectional area, light weight and corrosion free. Unlike steel guy wire, it also shows virtually no elongation over time.

According to the Australian importers GFS Electronics, the product is suited for use in supporting and guying applications both within the marine environment and throughout continental Australia. Its surface characteristics also reduce the adhesion of marine organisms.

Supporting high frequency radio antennas and guying their towers, where electrically conductive guys would adversely effect the antenna's radiation pattern, is a common application for Debeglass Wire. It is also ideally suited as a low cost support wire for running 'leaky' coaxial cables down mines and tunnels. In-field termination of Debeglass needs only a Debeclip and Phillips head screwdriver.

Manufactured in Japan, Debeglass wire uses modern technology to bind high tensile fibreglass yarn into a compact circular cross section. The bound yarn is then sheathed in a special blue coloured UV stabilised PVC.



Three sizes normally kept in stock by GFS Electronics are 4mm, 5mm and 6mm (OD). Tensile strength is 430kg, 620kg and 970kg respectively. Stocks of 8mm, 10mm and 12mm Debeglass Wire is available ex-Japan with deliveries of six to eight weeks. Tensile strengths of these sizes are 1710kg, 2470kg and 3420kg respectively.

For further information circle 244 on the reader service coupon or contact GFS Electronics, PO Box 97, Mitcham 3132; phone (03) 873 3777 or fax (03) 872 4550.

48mm panel mount package and is covered by a two year warranty.

For further information circle 246 on the reader service coupon or contact Fastron Technologies, PO Box 1212, Dandenong 3175; phone (03) 794 5566.

Fibre pigtailed diode laser

Melles Griot Electro-Optics has introduced a fibre pigtailed diode laser assembly which couples diode laser radiation into signal or multimode fibres. The 56 DPS series has been designed for applications where there are adverse shock, vibration and temperature conditions.

The assembly is used for medical equipment, optical tooling, semiconductor inspection, telecommunications, fibre optics sensors and metrology.

It is available with visible or infrared diode lasers and is offered in a range of wavelengths and output power levels. The user has a choice of diode lasers with nominal wavelengths from 635 to 830nm and output power levels from 0.5 to 30mW at typical operating currents. The infrared assemblies are capable of better than 55% optical efficiency and the visible assemblies are capable of more than 30% optical efficiency. The package size is less than 40mm in length.

The series produces a circular beam claimed to be free of astigmatism and spherical aberration. The housing of the diode laser assembly is made from stainless steel for enhanced durability and temperature stability.

The unit comes with a one metre length

PC Breeze II

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Herman Nacinovich, ETI review "It's a Breeze" Jan. 1990.

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of optical fibre. The standard product has a cleaved fibre end and the housing has a flange for easy mechanical positioning and heat sinking of the package. ST, FC and SC connectors are available as terminations to the fibre. Customised versions will be available on request.

For further information circle 248 on the reader service coupon or contact Spectra-Physics, 25 Research Drive, Croydon 3136; phone (03) 761 5200.

PCB eyelets

Palmtech now has available high-quality tin plated copper eyelets, suitable for making 'through hole' connections in short runs of double-sided PC boards, as an alternative to electroplating.

The eyelets are 2.2mm long (which is suitable for a standard 1.6mm thick PCB), with an OD of 1mm and an ID of 0.7mm to accept most standard component leads. They do not need forming, but are soldered on both sides. The matching drill size is either 1mm or 1.1mm, and PCB pads of .08" diameter are suitable.

Made in Switzerland, the eyelets are available in packs of 50 and 250 pieces. Retail prices are expected to be around $6.00 for the smaller pack, and $25.00 for the larger (sales tax included).

For further information circle 174 on the reader service card or contact Palmtech, Cnr Moonah and Wills Streets, Boulia 4829; phone (077) 463 109 or fax (077) 463 198.

Quartz frequency standard

Novatech Instruments has released the Model 2950A Quartz Frequency Standard, with simultaneous sinewave outputs at 5MHz, 1MHz and 100kHz. The 2950A is claimed to provide performance equal to or better than previously available standards, while costing many thousands of dollars less.

Three accuracy grades are available: the 2950A-01 with <1 x 10^{-9} daily aging rate, the 2950A-02 with <1 x 10^{-10} daily aging, and the 2950A-03 with <5 x 10^{-11} daily aging. Other features include high spectral purity (harmonics <-40dBc, spurious non-harmonic outputs <-70dBc) and low phase noise (-52dBc/Hz at 100Hz offset, for the -03 model). The 5MHz output can drive up to five 50-ohm loads. An internal rechargeable battery provides over two hours of standby power. A voltage control input is provided for fine frequency adjustment, for those who want to lock the unit to a primary standard.

Prices for the 2950A vary with accuracy grade, with the -01 version priced at US$995, the -02 version US$1395 and the -03 version US$1995.

For further information circle 175 on the reader service card or contact Novatech Instruments, 1530 Eastlake Ave East (#303), Seattle, Washington USA 98102; phone (206) 328 6902 or fax (206) 328 6904. ❖

Multimedia Units

Continued from page 111

hardware box that connects between the computer and monitor. We fed its composite video output to a high-quality Sony video monitor, to get a good idea of the resolution, and the results were again very impressive on typical material.

One thing we did discover, though, was that the MultiGen doesn't like graphics modes higher than 640 x 480 VGA. When some of the software we were using swung into higher modes, we got some rather weird results — but then, that's probably to be expected.

The other functions of the MultiGen, like freeze frame, overscan, fade, etc., were also very easy to use. You just press the appropriate button...

All told, then, we found both the ComputerEyes LPT and the Vine MultiGen very nice performers, and our impression is that they should have great appeal for people working in the multimedia area.

The quoted price for the ComputerEyes LPT is $650.80 plus tax ($760 incl.), while that for the MultiGen is $1150 plus tax ($1330.60 incl.). For further information contact Lako Vision, Suite 4, 15-17 Pakington Street, St Kilda 3182; phone (03) 525 3899, or fax (03) 525 3977. ❖

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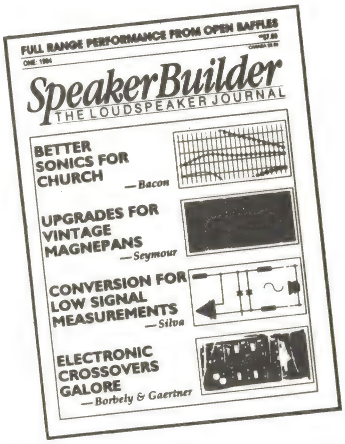

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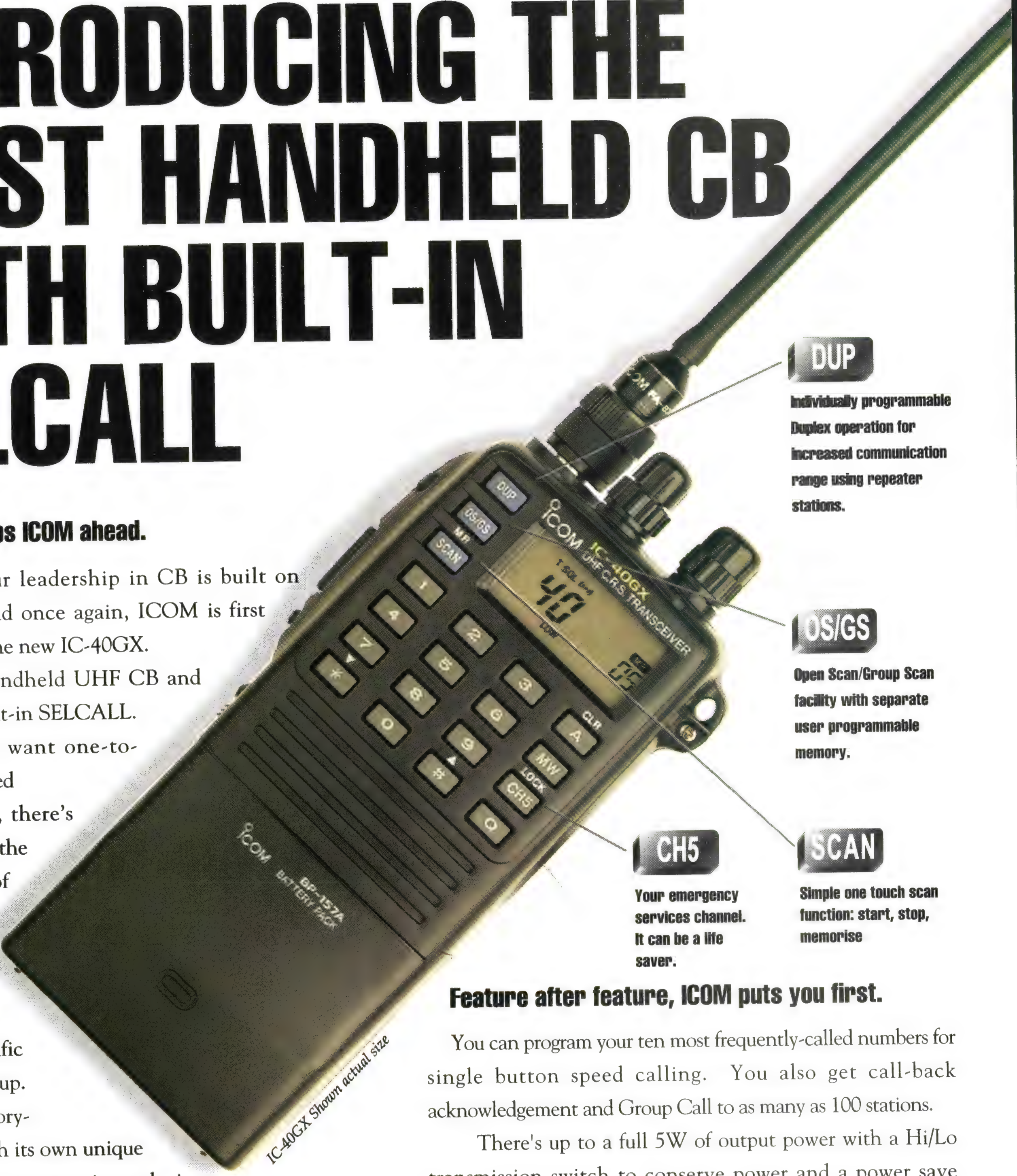

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Data Acquisition Feature:

Data acquisition for Notebook PCs

Notebook PCs, with computing power rivalling top-end desktop systems, are an ideal platform for cost efficient, portable data acquisition (DAQ) systems. However, because most notebook PCs do not include expansion slots for plug-in DAQ boards, National Instruments has developed two alternatives using technologies that are becoming standard items on notebook PCs: Personal Computer Memory Card International Association (PCMCIA) slots and high speed parallel printer ports.

by DAVID POTTER

Signal Conditioning Marketing Manager, National Instruments

NATIONAL INSTRUMENTS
DAQPad-1200
PCMCIA-GPIB
DAQCard-700

Three of the National Instruments products designed to allow convenient data acquisition using a laptop: the DAQCard-700, the PCMCIA GPIB card and the DAQPad-1200.

Newer notebook PCs have a standard PCMCIA slot that accepts credit card sized expansion devices, usually memory boards and modems. A PCMCIA card with multi-function I/O functionality, such as the National Instruments DAQCard-700, adds high performance data acquisition and control capability to notebook PCs. The DAQCard-700 has 16 single ended or eight differential analog inputs, a 12-bit ADC, a 100kS/s sustained sampling rate, and 16 TTL-compatible digital I/O lines.

The PCMCIA card is completely configured and calibrated by software. A custom designed 50-pin I/O connector and cable route all input and output functions to a standard 50-pin ribbon cable. The DAQCard-700, a Type II PCMCIA card, uses very little power, making it ideal for battery powered PCs. Where compactness is the number one concern, the DAQCard-700 is the ultimate space saver.

For applications that require signal conditioning or more channels, you can add external analog and digital SCXI signal conditioning modules. However, one limitation is that the DAQCard-700 cannot perform high speed, multi-channel scanning of SCXI analog inputs. In other words, software must control the scanning of multiple analog input channels of an SCXI module, which will consequently be relatively slow. You can overcome this scanning limitation, however, with an SCXI system that connects directly to the PC parallel port.

Using the parallel port

The parallel printer port, found on almost every notebook and desktop PC, is a natural for external DAQ peripherals. Unlike the serial port, external DAQ modules linked to the

NATIONAL INSTRUMENTS
DAQPad-1200
Dynamic Signal Analyzer.vi

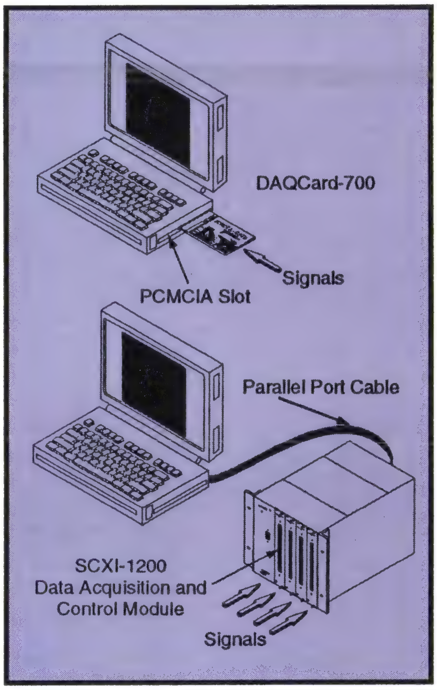
The DAQPad-1200 can be used with any PC that has a parallel printer port.

parallel printer port can transfer data directly to computer memory at high transfer rates that are comparable with plug-in DAQ boards.

For example, the SCXI-1200 12-bit data acquisition and control module can transfer acquired data to the PC at 60kS/s when connected to an Enhanced Parallel Port (EPP), a new bidirectional parallel port standard defined by IEEE 1284, or 20kS/s when connected to a standard Centronics port. The SCXI-1200 module includes eight single ended or four differential inputs, programmable gains of up to 100, and an 83.3kS/s 12-bit ADC.

The module also includes two 12-bit analog output channels, 20 to 24 lines of TTL-compatible digital I/O, and three counter/timers.

The SCXI-1200 can control and acquire data from up to 11 other SCXI modules, making it ideal for portable applications with signal conditioning or large channel count requirements. Unlike the DAQCard-700, the SCXI-1200 can use the SCXI chassis hardware scanning capability to scan conditioned analog input signals from other SCXI modules at the full hardware rate of the SCXI-1200. A system that includes the SCXI-1200 and the new DC-powered SCXI-1000DC chassis is a powerful combination of portability and expandability.



PCMCIA slots and high speed parallel printer ports are two different approaches to data acquisition on notebook PCs.

Another parallel port option is to use an external DAQ box, such as the DAQPad-1200. The DAQPad-1200 is compatible with any PC that has a parallel printer port, making it ideal for PC based DAQ applications involving laptop and notebook PCs, or PCs with the available slots filled. It has a 12-bit ADC that can digitise signals from eight single ended or four differential inputs at rates up to 100kS/s. It features programmable gain of 1, 2, 5, 10, 20, 50 or 100; a 2-ksample first in first out (FIFO) ADC buffer; two 12-bit DACs with voltage outputs; 24 lines of TTL-compatible digital I/O; and three user-available 16-bit counter/timer channels.

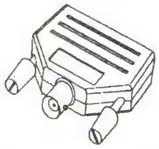
The DAQPad-1200 is compatible with the EPP standard and works with two types of ports — standard Centronics (unidirectional) and the fast EPP ports. In EPP mode, data is transferred at rates up to 100kS/s. The DAQPad-1200 also features a second parallel port connector, so users can simultaneously connect the unit to a PC and a printer.

For further information on the DAQ products mentioned in this article, contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 879 9422, or fax (03) 879 9179. ❖

LOW COST VIRTUAL INSTRUMENTS FOR PCs

The PICO Technology range are unique low cost data acquisition products for IBM PCs and compatibles. Installed in seconds, they simply plug directly into either the serial or parallel port. Each device comes with PicoScope Software (Oscilloscope, TRMS Voltmeter, Spectrum Analyser), PicoLog (Advanced Data Logging software) or both. Also includes C, Pascal and basic drivers to develop your own software.

ADC-10



- Single channel 8 bit Inputs, 0-5V
- Up to 24kHz Sampling Rate
- Includes PicoScope Software

ADC-10 $126 + TAX
ADC-10 with PicoLog $152 + TAX

ADC-11

- 11 Channel, 10 bit Inputs, 0-2.5V
- Up to 15kHz Sampling Rate
- Includes PicoScope Software

ADC-11 $219 + TAX
ADC11 with PicoLog $245 + TAX

ADC-12

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Typical applications:

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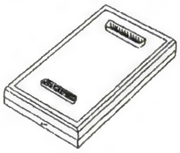
ADC-16



- 8 Channel, 16 bit Plus Sign Inputs
- +/- 2.5V Input Range
- Includes PicoScope Sofware

ADC-16 with PicoLog $298 + TAX

ADC-100 HI-SPEED

- Dual Channel 12 bit Inputs
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Special feature:

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RATE
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MODE
RESET
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Computronics

Computronics has released its Digimeter which is claimed to revolutionise flow monitoring up to 200l/m. The flow body is moulded from fibreglass reinforced nylon.

The rotor has rare earth magnets of a strength 350 times their own weight, which induce 112 pulses per litre to the electronic circuitry. The electronics are battery powered and a powerguard shuts off the display after 30 minutes if the meter is not used.

All features are software programmed and include automatic on/off, flow rate, flow quantity and batch reset while total continues counting. The Mode key allows different pulse rate to be entered for liquids other than water, such as diesel fuel, kero, oils, slight alkaline and acidic liquids. The standard Digimeter is ready to go. Alternatives based on this design include remote displays and bypass metering for flow rates up to 1000l/m.

For further information 202 on the reader service coupon or contact Computronics, PO Box 8076, Stirling Street, Perth 6849; phone (09) 221 2121.

Relay outputs on I/O card

Procon Technology has released a new version of its eight opto-isolated input and eight relay output board for 'real world' computer control applications. The PC-100-G6C-24V AC board, designed and manufactured in Australia, provides eight SPDT relays rated at 10 amps at 240V AC or 30V DC (maximum switching voltage 380V AC or 125V DC) and provides eight digital 12 to 24 volt AC or DC opto-isolated inputs. Connection is via screw terminals. Each board measures 240 x 100mm and can be DIN rail mounted.

A single interface card (PC-BD-IO) plugs into an eight-bit card slot of an IBM PC or compatible computer and drives up to 16 externally mounted boards. This provides up to 128 inputs and 120 outputs. Alternatively, the boards may be driven from a standard bi-directional printer port available on most laptop and IBM PS/2 computers. This provides expansion up to 64 inputs and 56 outputs. Other boards are available in the range, including a 16 relay output board, a 32 opto-isolated input board and an industrial option board that provides plug in relays and detachable screw terminals. All boards come with example software for programming from most languages (including Windows based languages) and are compatible with Procon's

---

Floppy disk based high speed recorder

A new floppy disk-based high speed transient recorder featuring 1MB of acquisition memory has been released by Yokogawa. The new ORM1200 recorder complements Yokogawa's recently released memory card recorder, the ORP1200.

The ORM1200 can be connected directly to voltages from millivolt levels up to +/-500V, and a wide range of thermocouples. Four, eight or 16 input channels can be fitted, with an optional further 16 logic channels available. Like the OPR1200, the ORM1200 incorporates a pen recorder, oscilloscope, memory recorder and X-Y recorder in one portable unit. The real time electroluminescent display is able to show input waveforms exceeding 50Hz without envelope effects.

Chart output is by a 200mm thermal array, which can record input signals or reprint memory data in A4 or A5 size for convenient hard copy filing or transmission by fax.

Data logging without chart output beyond the ORP1200's internal 128K per channel is possible by logging captured data to the standard 1.44MB floppy disk. Data is stored in MS-DOS format, and can be read by most PC compatible computers, or reviewed on the ORM1200's screen.

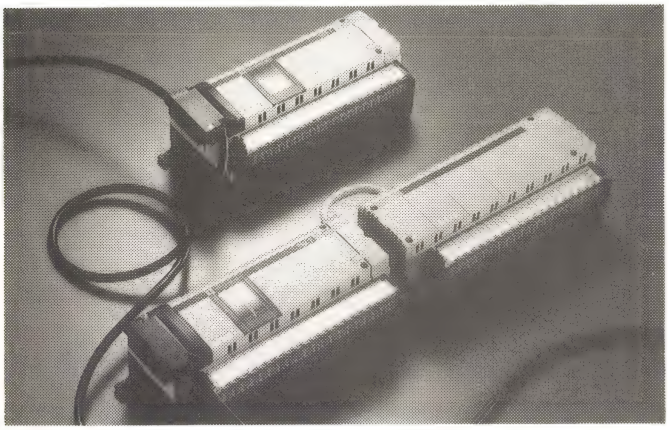
For further information circle 201 on the reader service coupon or contact Yokogawa Australia, Private Mail Bag 24 PO, North Ryde 2113; phone (02) 805 0699.

Programmable Logic Control language that provides a relay ladder logic style of control capability.

For further information circle 204 on the reader service coupon or contact Procon Technology, PO Box 655, Mt Waverley 3149; phone (03) 807 5660.

Remote I/O

Schneider has announced the release of a new range of remote I/O products in Australia from Telemecanique. The new TBX range of modular remote I/O devices is designed for distributed architectures to comply with the new worldwide FIP standard and is claimed to significantly streamline automation projects through low cost wiring, combined with vastly simplified installation, setting up and operating procedures.



Telemecanique has adopted a modular approach with this product range, to enable selection of an optimum number and configuration of modules based on the number of I/O for the application. The TBXs are constructed with three removable parts: a base unit containing the electronics for adapting I/O signals, a detachable terminal block and a communicator for the FIPIO bus. The base unit can be installed and wired in advance, while the communicator and its link to the bus would be connected during final installation. Monobloc TBX's are connected directly to FIPIO and also have a removable I/O terminal block.

For further information circle 207 on the reader service coupon or contact Schneider Australia, Unit 1, Block Q, Regents Park Estate, Princes Road East, Regents Park 2143; phone (02) 743 7700.

Low frequency accelerometer

PCB Piezotronics has introduced the model 356A08 Triaxial Accelerometer. The lightweight, 18 gram, aluminium housing minimises mass loading effects and is laser welded to protect internal components from contamination. A high output, low noise, 100mV/g signal is generated by rugged shearmode, piezoceramic sensing elements coupled to built-in signal conditioning circuitry. Additional benefits of this shear mode device include a broad frequency range of 0.5 to 5000Hz and reduced sensitivity to thermal transients, base strain and transverse motion.

Built-in microelectronic circuitry conditions the sensor's output signal to a low impedance voltage that is capable of driving long lengths of low cost cable, with no appreciable degradation. System setup is simplified as only a constant current regulated, DC voltage condition is required to energise the sensor and couple the analog measurement signal to a readout, recording or control device.

For further information circle 208 on the reader service coupon or contact M.B. & K.J. Davidson, 17 Roberna Street, Moorabbin 3189; phone (03) 555 7277. ◆

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Wireless data logging for your PC.

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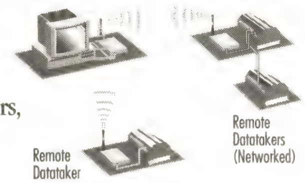

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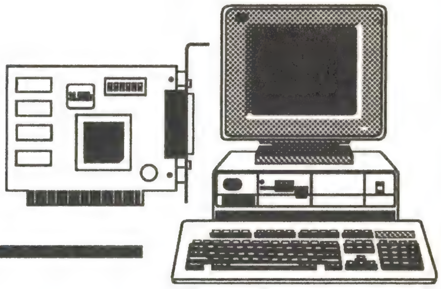
Computer News and New Products



Low cost logic analyser

For the cost of a logic probe, this new software product allows you to use your IBM compatible computer as a fully functional logic analyser. Up to five signals can be monitored through the standard PC parallel printer port, which is connected to the circuit under test using a simple cable and optional buffer.

The software can capture 64K samples of data at speeds up to 1.2us (depending on computer), and display them graphically at a number of different zoom levels. Four independent cursors allow accurate time and frequency measurements to be made, and waveforms can be printed out or saved to disk for later recall and analysis.

Triggering can be set to any combination of high, low or 'don't care' values, and allows for adjustable pre-trigger and post-trigger viewing. The software runs under DOS or Windows, providing a very convenient tool for development, servicing and education.

For further information circle 161 on the reader service coupon or contact Gray Enterprises, PO Box 75, Takanini, Auckland NZ; phone (64) 9 298 7356.

Loudspeaker design software upgrade

Australian company Audiosoft has released new versions of its CALSOD, BassBox and Xover software packages. CALSOD (Computer-Aided Loudspeaker System Optimisation and Design) is now up to version 3.00 and is able to import measurement files from IMP, the software in the IMP Speaker Testing Package projects, starting in this month's issue of EA.

According to its designer, CALSOD 3.0 will allow IMP users to have a sophisticated crossover optimisation capability, with the ability to make direct use of the measured data that contains magnitude and phase response information. The recommended retail price of CALSOD 3.0 is $399.

BassBox, a program to design speaker enclosures, is up to version 5.0. The companion program Xover is now at version 2.0.

For further information circle 163 on the reader service coupon or contact Audiosoft, 128 Oriel Road, West Heidelberg 3081; fax (03) 497 4441.

Ethernet transceiver for thin coax

INC Manufacturing, an Australian manufacturer and marketer of Local Area Network connectivity products for AS400, Ethernet and Token Ring networks, has released its TP2 INC Ethernet transceiver for thin coaxial cable, completing its range of Ethernet transceivers.

The TP2 provides connection from an AUI (15-pin D-type) connector for thick coaxial cable on an Ethernet host to a 10Base2 (BNC) thin coaxial connector. The host can be an Ethernet card, an adaptor or a 10Base2/10Base5 repeater. An important feature of the transceiver is the signal quality error (SQE) switch, which provides heart beat for detection of network data collision. The TP2 transceiver has a recommended price of $140, excluding tax.

INC
Model TP2
Ethernet
Coaxial Cable
Transceiver
Power
SQE

For more information circle 162 on the reader service coupon or contact INC Manufacturing, Unit 2, Block R, 391 Park Road, Regents Park 2143; phone (02) 645 2200.

Statgraphics Plus for Windows

Manugistics has launched a Windows version of its statistical graphics analysis tool, Statgraphics Plus. A true Windows application, Statgraphics Plus for Windows retains all the interactive graphics and ease of use features of its DOS counterpart, while introducing several new concepts for Windows applications, including StatFolio, an innovative function that allows users to save and re-run statistical procedures and analyses automatically.

Statgraphics Plus for Windows contains the most common statistical functionality including simple and multiple regression; ANOVA; one, two, and

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multiple variable analyses; distribution fitting; tabulation and cross-tabulation. Separate modules containing statistical routines specifically for quality control, experimental design, time series analysis and multivariate statistics are also available.

Using DDE, users of the most popular Windows spreadsheets can manage their data within their spreadsheet, dynamically linking it to the Statgraphics data editor. This data can then be used within Statgraphics with any changes to the spreadsheet being reflected in updated statistical output and graphics.

For further information circle 164 on the reader service coupon or contact Hearne Scientific Software, Unit 36, 458 St. Kilda Road, Melbourne 3004; phone (03) 866 1766.

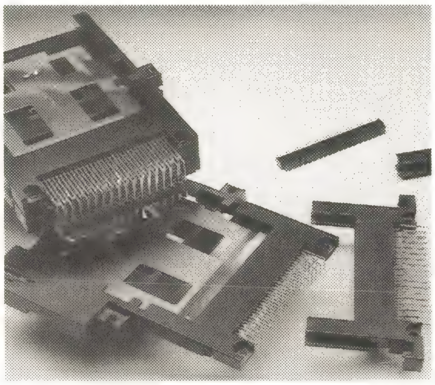
Monitor surface reduces eye strain

NEC Australia has announced details of their new OptiClear surface. According to a company spokesperson this combines a number of screen treatments such as anti-reflection, antiglare and anti-static, and incorporates them into one surface similar in quality to a liquefied bonded panel, but at a fraction of the cost.

Many monitor users complain of eye strain and focusing problems, and the most common cause is the amount of glare and reflection from the monitor screen. NEC claim that the OptiClear surface absorbs a portion of this incident light and the image displayed is free of the usual distortion caused by common etched or slice-coated screens.

The OptiClear surface is currently manufacturered on the NEC MultiSync 5FGp and 6FGp professional colour monitors. The MultiSync 5FGp and 5FGp are available at a recommended retail price of $2861 and $5499 (including tax) respectively, from NEC Home Electronics distributors and dealers Australia wide.

PCMCIA sockets and plugs



A broad line of both sockets and plugs meeting PCMCIA and JEIDA standards are now available from Samtec. The new PCMCIA solution guide provides complete technical specifications and ordering information on these products.

Standard plugs (PCMP series) are available in traditional horizontal through-hole footprints, as well as standard and low profile surface mount versions. Vertical mount designs are also available.

Standard options on most plugs in-

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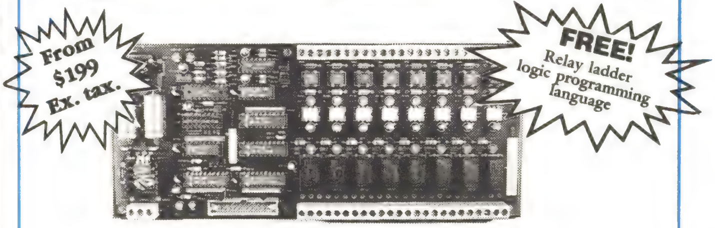
The system features: External mounting (up to 30 metres from computer) operating through any IBM-PC bi-directional printer port and capable of expanding to 240 I/O.

Applications: Home or business security systems, process monitoring and control, laboratory automation, quality control testing, robot control and energy management.



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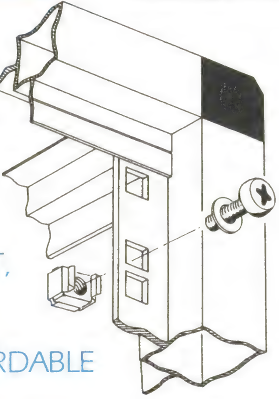

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clude left hand and right hand ejector buttons, electro-static discharge clips and locking clips. An 88-pin plug for DRAM cards is also available.

Two socket styles (PCMS series) are currently available: straddle mount for connecting to both sides of the board and surface mount for single sided termination.

For further information circle 166 on the reader service coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

Australian made IBM compatible

Comnet Australia has announced its range of Big Red computer microsystems. These computers are claimed to offer the latest technology from IBM and Intel and to represent exceptional value for money.

The heart of Big Red is the three year warranted IBM LX motherboard and the product is ISO and AS compliant. The processor is the 486SLC2 chip used extensively in the IBM PS/2 range. It has an open architecture with AMI BIOS and OPTI chipset, and offers both ISA and VESA options.

The 486SLC2 is a high performance, low power single chip 32-bit microprocessor which features 16KB of on-chip cache and a two-to-one internal clocking that allows the processor to function at twice the bus frequency.

The series comprises 486 50MHz ISA, 50MHz VESA and 66MHz VESA versions. The overall chip design is optimised to improve the processor performance on frequently used instructions, and the 486SLC2 is fully compatible with other Intel microprocessors. Comnet Australia offers a national three year on-site warranty.

For further information circle 168 on the reader service coupon or contact Comnet Australia, 67-69 Alexander Street, Crows Nest 2065; phone (02) 439 5956.

External data acquisition

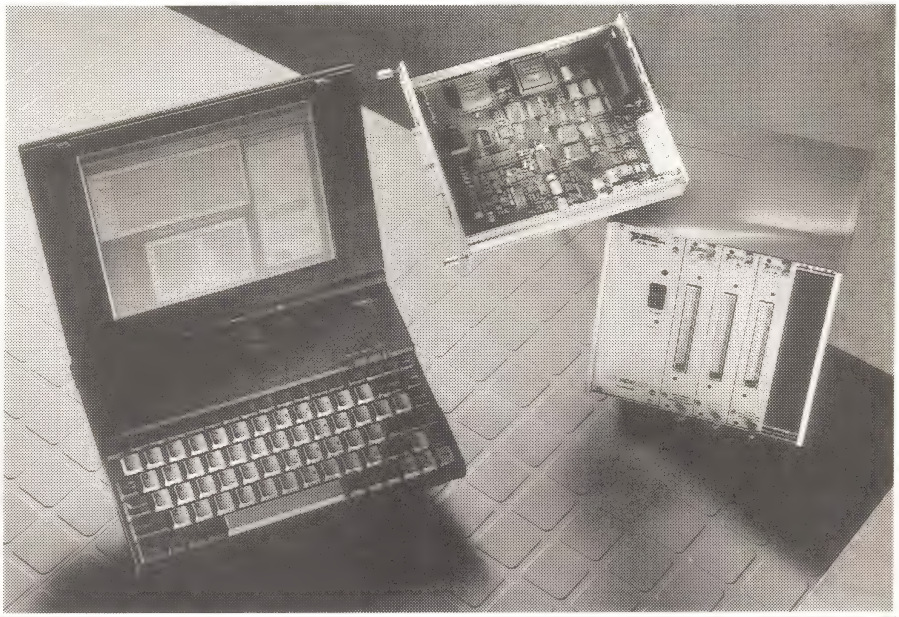
National Instruments has announced a new multi-function data acquisition and control module for SCXI product line. The SCXI-1200 eliminates the need for a PC expansion slot by moving the data acquisition (DAQ) hardware out of the PC and into the SCXI signal conditioning chassis.

System developers can combine the SCXI-1200 with an SCXI chassis and up to 11 signal conditioning I/O modules to create a portable, flexible data acquisition and control system. The SCXI-1200 module is compatible with any PC that has a parallel printer port, making it an ideal solution for portable or remote data acquisition applications. The SCXI-1200 has a 12-bit ADC that can digitise signals from other SCXI signal conditioning modules or from eight single ended or four differential inputs.

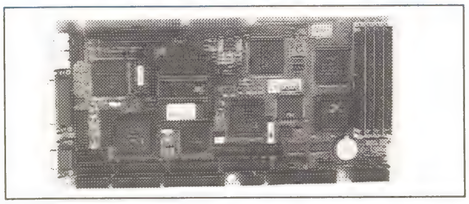
It features a programming gain of 1, 2, 5, 10, 20, 50 or 100; a 512-sample first-in first-out ADC buffer; two 12-bit DACs with voltage outputs; up to 24 lines of TTL-compatible digital I/O; and three user available 16-bit counter/timer channels.

Software includes NI-DAQ, the company's library of DAQ functions for DOS, Windows, and Windows NT applications. The SCXI-1200 is compatible with LabView, LabWindows for DOS, and LabWindows/CVI.

For further information circle 170 on the reader service coupon or contact National Instruments Australia, PO Box 382, North Ryde 2113; phone (02) 878 6758. ◆

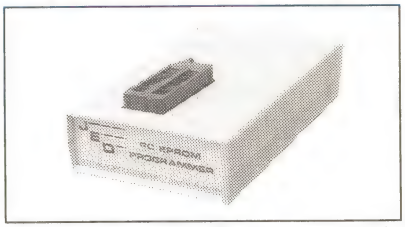


Australian Computers & Peripherals from JED... Call for data sheets.



The JED 386SX embeddable single board computer can run with IDE and floppy disks, or from on-board RAM and PROM disk. It has over 80 I/O lines for control tasks as well as standard PC I/O. Drawing only 4 watts, it runs off batteries and hides in sealed boxes in dusty or hot sites.
It is priced at $999 (25 off) which includes 2 Mbytes of RAM.

$125 PROM Eraser,complete with timer



$300 PC PROM Programmer.

(Sales tax exempt prices)

Need to programme PROMs from your PC?

This little box simply plugs into your PC or Laptop's parallel printer port and reads, writes and edits PROMs from 64Kb to 8Mb.
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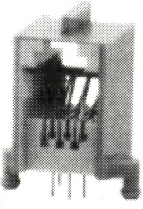

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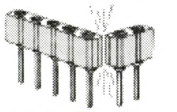
Ideal for telephone projects and at our price you should get a few now! ONLY $1.00 each!



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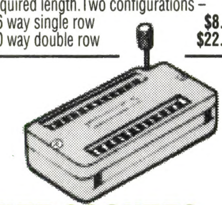

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Temperature Sensors

LM35DZ	Centigrade Sensor	**$2.85**
LM335H	Volt Mode Temp Sens	**$4.95**
LM335Z	Volt Mode Temp Sens	**$3.95**
LM3911N	Temperature Contrlr	**$2.85**

A/D & D/A

14433	3 1/2 Digit A/D	**$27.25**
ADC0804LCN	8 Bit A/D 1 LSB	**$6.05**
ADC0809CCN	8 Bit A/D 8 Ch Mux	**$7.40**
ADC0817CCN	8 Bit A/D 16Ch Mux	**$17.80**
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ADC0830BCN	********	**$23.55**
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Regulators

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TL074CN	Quad JFET Amplifier	**$1.50**
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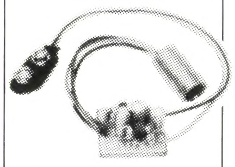
SUPER MAGNETS

We have added two RARE EARTH magnets to our range, and reduced their price. Very powerful: You will not be able to separate two of these by pulling them apart directly away from each other and you should be careful when handling these! Some claims were made on recent TV shows regarding the usage of powerful magnets like these in medical applications. **CYLINDRICAL 7 x 3mm $2, Item No. 0224A, CYLINDRICAL 10 x 3mm $4, Item No. 0224B, TOROIDAL 35mm 35 inner 7mm thick $9.50, Item No. 0224C.**

3mW VISIBLE LASER DIODE SPECIAL



We have bought a surplus quantity of some BRAND NEW Toshiba TOLD9200 3mW-670nM visible laser diodes and are offering a kit that includes one of these diodes, plus an APC driver kit, plus a collimating lens-heatsink assembly. That's a complete 3mW collimated laser diode kit for a RIDICULOUS TOTAL PRICE OF:

$45

Item No. 0164B

BIGGER LASER

We have a good, but LIMITED QUANTITY of some brand new red 3mW+ tubes, and some "As New" red 6mW+ laser heads that were removed from new equipment. Tube dimensions (3mW+): 35mm diameter by 190mm long. Head dimensions (6mW+): 45mm diameter by 380mm long. With each of the lasers we will include our 12V Universal Laser power supply. BARGAIN AT:

$110 – 3mW+ tube/supply, Item No. 0225A

$170 – 6mW+ head/supply, Item No. 0225B

12A SOLID STATE RELAYS

Removed from BRAND NEW equipment. Isolated Mitsubishi 240V-12A solid state relays (Type SF120DPS-H1-4) need a few milliamperes from a 4-7V (even higher if a resistor is added) DC source to operate. Great for switching mains appliances from logic circuitry. Screw connections provided, overall dimensions 41 x 47 x 20mm. Available at about 1/4 of their real value. Item No. 0218NS.

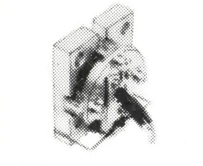
$14

MAINS CONTACTOR RELAY

Approved mains contactor that has a 24V-250 ohm relay coil, and four separate SPST switch outputs. Two of the output contacts are rated at 20A and the other two at 10A. Removed from new equipment, Omron brand, connection is by spade connectors (provided), mounting bracket provided, relay body dimensions: 60x60x35mm. Item No. 0219NS.

$8

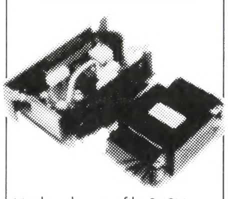
IR LASER DIODE SURPLUS SPECIAL



BRAND NEW 780nM Laser Diodes (barely visible), mounted in a professional adjustable collimator-heatsink assembly. Each of these assemblies is supplied with a Constant Current Driver kit and a suitable Pin Diode that can serve as a detector, plus some Instructions. Suitable for medical use, perimeter protection, data transmission, IR illumination etc. Item No. 0223NS.

$28

SWITCHED MODE POWER SUPPLIES WITH ISOLATION TRANSFORMER

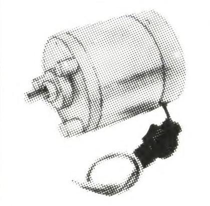


Modern low profile 240V-30V AC transformer (125x80x40mm, 1.8 kg), plus a totally self contained matching switched mode regulated power supply (165x55x90mm, 0.4kg): Interconnecting leads and plugs/sockets and information is provided. Regulated DC outputs: +24V/2A, +12V/0.5A, +5V/0.5A and −12V/50mA. We do not have the full specifications on these two matching units that were removed from BRAND NEW laser printers, but have tested the transformer with a 100W load. We have a LIMITED supply at below the value of the transformer itself.

$28

For the 240-30V transformer, the matching switched mode supply, the interconnecting leads with matching plugs and sockets and information. Item No. 0215NS.

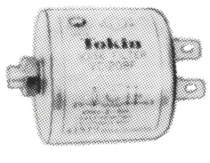
LARGE DC MOTOR-GENERATOR



Matsushita permanent magnet DC motors that were removed from brand new equipment and are rated for 20V operation. Very powerful when powered from a 6-20V DC supply. No load current @ 12V is 200mA. Weight 0.7 kg, 75mm diameter, 90mm long; have a 5mm dia. fluted shaft which is 14mm long and have sealed ball bearings. Also have a separate tachometer circuit built in which produces 50 pulses per revolution when powered from a 5V supply: Connecting up information provided. These motors can also double up as a generator. Can be used for powering a small vehicle, experimentation with wind powered systems, etc. Item No. 0216NS.

$18

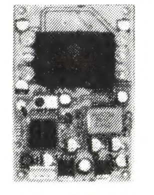
MAINS FILTERS



240V-8A made by Tokin in Japan. Removed from new equipment, are in a cylindrical metal case, mounting screw/nut and spade connectors provided: Diameter 44mm, 40mm long. Internal circuit includes 2x1.5mH inductors, 2x0.47µF capacitors, 2x4700pF capacitors and 1x470Kohm resistor. Surge suppressing varistor provided with each filter. Good, but LIMITED STOCK. Item No. 0221NS.

$9

CCD CAMERA

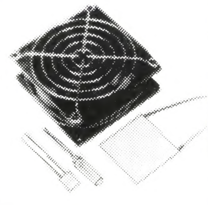


Monochrome CCD Camera which is totally assembled on a small PCB and includes an Auto Iris lens. It can work with illumination of as little as 0.1 Lux and it is IR responsive. Can be used in total darkness with Infra Red illumination. Overall dimensions of camera are 24 x 46 x 70mm and it weighs less than 40 grams! Can be connected to any standard monitor or the video input on a Video cassette recorder.

$239

Item No. 0227

SOLID STATE "PELTIER EFFECT" COOLER-HEATER



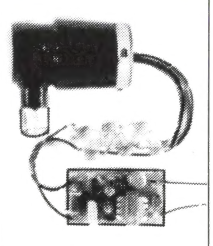
These are the major parts needed to make a solid state thermoelectric cooler-heater. We can provide a large 12V-4.5A Peltier effect semi-conductor, two thermal cut-out switches and a 12V DC fan for a total price of:

$45

Item No. 0231

We include a basic diagram – circuit showing how to make a small refrigerator-heater. The major additional items required will be an insulated container such as an old "Esky", two heatsinks and a small block of aluminium.

IMAGE INTENSIFIER TUBE AND SUPPLY



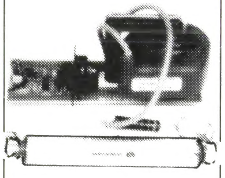
These are the key components needed for making a PASSIVE NIGHT VIEWER. The small pre-focused Russian image intensifier tube only requires a low current EHT power supply to make it operational, which we provide in kit form. Draws 20mA from a small 9V battery. With a suitable low light objective lens (not provided), the resultant viewer will produce useful pictures in sub-moonlight illumination and it can also be IR assisted. INCREDIBLE PRICE.

$150

Item No. 0232A

For the Russian image intensifier tube and an EHT power supply kit! All that is needed to make a complete passive night viewer is a lens, an eyepiece, a 9V battery, a case and a switch. We can supply a matching lens and eyepiece: **$68 for the pair.** Item No. 0232B

BUDGET LASER

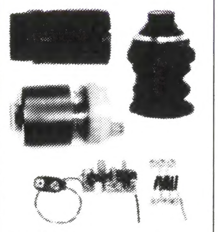


A very economical Laser tube – 12V laser supply combination. The 12V switched mode power supply kit provides the tube with a constant current and will work from 10-15V, draws 0.5A at 12V. Very efficient! The tube supplied is used, tested and guaranteed, 632.8nM (Red), power output 0.5-1mW. The tube-power supply kit combination for a total price of only:

$49

Item No. 0233

IR "TANK SET"



ON SPECIAL is a set of components that can be used to make a very responsive Infra Red night viewer. The matching lens tube and eyepiece sets were removed from working military quality tank viewers. We also supply a very small EHT power supply kit that enables the tube to be operated from a small 9V battery. The tube employed is probably the most sensitive IR responsive tube we ever supplied. The resultant viewer requires low level IR illumination. Basic instructions provided. Item No. 0228UTS.

$120

For the tube, lens, eyepiece and the power supply kit. When ordering specify preference for a wide angle, or telescopic objective lens.

DC FANS

These IC controlled 24V-110mA 3 inch ball bearing Japanese made DC fans work well from 5-24V. They also move a good amount of air whilst drawing 60mA from a 12V battery. Item No. 0217NS.

$8

FIBRE OPTIC TUBES

These US made tubes are used but in excellent condition. Have 25/40mm diameter, fibre-optically coupled input and output windows. The 25mm tube has an overall diameter of 57mm and is 60mm long. The 40mm tube has an overall diameter of 80mm and is 92mm long. The gain of these is such that they would produce a good image in approximately half moon illumination when used with suitable "fast" lens, but they can also be IR assisted to see in total darkness. The superior resolution of these tubes would make them suitable for low light video preamplifiers, wild life observation and astronomical use. Each of the tubes is supplied with a 9V EHT power supply kit. INCREDIBLE PRICES:

$120 For the 25mm intensifier tube and supply Item No. 0230A

$190 For the 40mm intensifier tube and supply Item No. 0230B

Three of these tubes can be cascaded to make a very high gain image intensifier! We should have a kit and instructions available to make these. Approximately **$270** for 25mm kit and **$450** for the 40mm three stage kits. We will also have available some made up three stage tubes.

12V-2.5 WATT SOLAR PANELS

These U.S. made amorphous glass solar panels only need terminating and weather proofing. We provide terminating clips and a slightly larger sheet of glass. The terminated panel is glued to the backing glass around the edges only. To make the final weatherproof panel look very attractive some inexpensive plastic "L" angle could also be glued to the edges with some silicone. Very easy to make. Dimensions: 305 x 228mm, Vo-c: 18-20V, Is-c: 250mA. BARGAIN PRICED.

$25 each or 4 for $80

Item No. 0226

Each panel is provided with a sheet of backing glass, terminating clips, an isolating diode and the instructions. Higher quantity discounts apply on this item. Ring!

OATLEY ELECTRONICS

PO Box 89, Oatley, NSW 2223

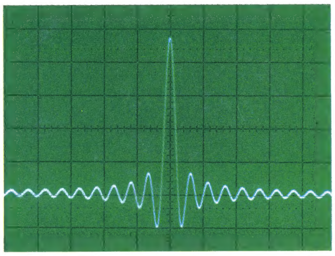
Telephone: (02) 579 4985 Fax: (02) 570 7910

MAJOR CARDS ACCEPTED WITH PHONE AND FAX ORDERS

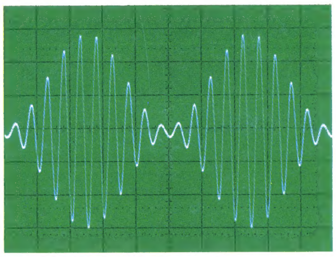
P & P ANYWHERE IN AUSTRALIA
FOR MOST MIXED ORDERS: $2.50-$10

READER INFO NO. 2

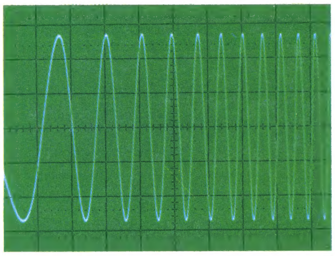
There are many areas where our function generator will surpass your expectations.



A built-in 12-bit, 40 MSample/sec, 16K deep arbitrary waveform generator easily handles your custom waveform needs.

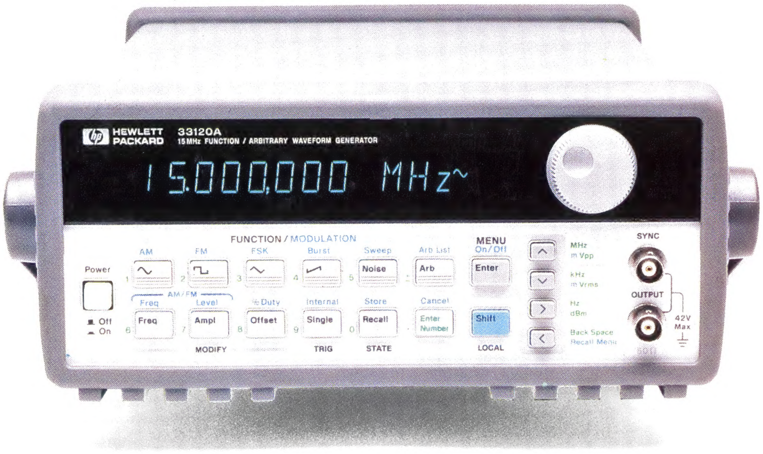


Internal AM, FM, FSK and burst modulation eliminate your need for a second modulation source.



Both linear and log sweeps are built in, making filter and amplifier testing quick and easy.

At a price that falls below them.



The HP 33120A 15 MHz synthesised function/arb generator: Within budget, without compromise.

In the world of function generators, price and performance have always been synonymous. So it's understandable you'd expect to pay more for the measure of confidence you get with a synthesised signal source that delivers stable, accurate signals test after test. Or, for the flexibility to generate complex waveforms with arbitrary waveform capability.

You'd probably also expect to pay a premium for the convenience of built-in sweep and modulation functions. And to have both HP-IB and RS-232 interfaces standard.

Fact is, you can always get high performance with the high price to match. Or, order the HP 33120A fully loaded function/arb generator and get something totally unexpected. A price you can afford.

Call HP to see how much function generator you can get for your money.

Discover just how easy it is to afford a fully loaded 15 MHz function/arb generator with synthesised signal source and arbitrary waveform capability. Once you hear the price, we think you'll agree it's the best deal of any function generator in its class.

In fact, you can learn more about the HP 33120A function/arb generator's custom waveform capability, signal accuracy, easy programmability and any other specifications you may need to make the right decision.

So call our Customer Information Centre on **13 1347** (Australia wide) and ask for extension **2902.**

A better way.

HEWLETT® PACKARD